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Economic Impact Analysis of Effluent Limitations and Standards for the Coal Mining Industry

Arthur D. Little, Inc.
Cambridge, MA

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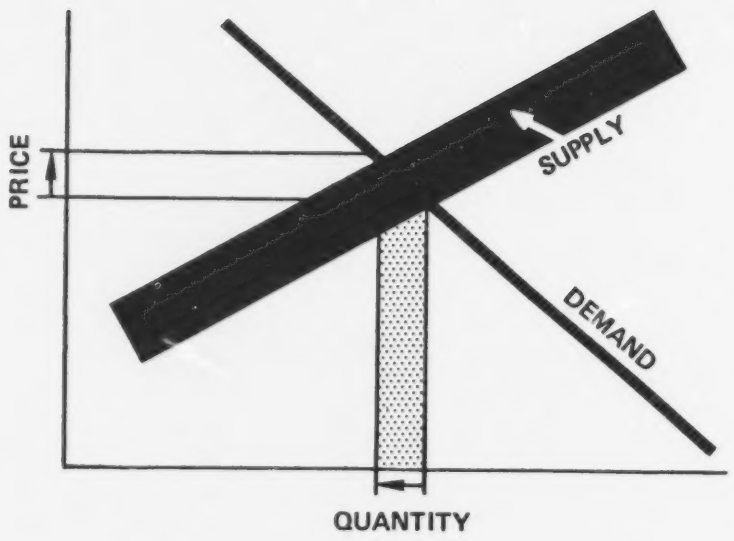

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The U.S. Environmental Protection Agency issued effluent guidelines and limitations for the Coal Mining Point Source Category in September 1982. This report estimates the economic impact of pollution control costs in terms of price changes, effects on profitability, potential mine closures, unemployment, and other secondary effects. A linear program is used to estimate these impacts and the supply of coal in the spot, contract, and metalurgical coal markets. Impacts on new coal preparation facilities are also examined.

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ECONOMIC IMPACT ANALYSIS OF EFFLUENT LIMITATIONS AND STANDARDS FOR THE COAL MINING INDUSTRY

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER REGULATIONS AND STANDARDS
WASHINGTON, D.C. 20460

October 1982

PREFACE

This document is a contractor's study prepared for the Office of Water Regulations and Standards of the Environmental Protection Agency (EPA). The purpose of the study is to analyze the economic impact which could result from the application of effluent standards and limitations (issued under Sections 301, 304, 306 and 307 of the Clean Water Act) to the coal mining industry.

The study supplements the technical study (EPA Development Document) supporting the issuance of these regulations. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports certain standards and limitations based upon an analysis of the feasibility of these standards in accordance with the requirements of the Clean Water Act. Presented in the Development Document are the investment and operating costs associated with various control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the application of various control methods and technologies. This study investigates the effect in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Water Regulations and Standards of EPA. This report was submitted in fulfillment of Contract No. 68-01-4466 by Arthur D. Little, Inc. The analysis was completed in December 1981.

This document is an economic impact assessment of the recently-issued effluent guidelines. The report should be directed to the staff responsible for writing industrial discharge permits. The report includes detailed information on the costs and economic impacts of various treatment technologies. It is should be helpful to the permit writer in evaluating the economic impacts on an industrial facility that must comply with BAT limitations or water quality standards.

If you have any questions about this report, or if you would like additional information on the economic impact of the regulation, please contact the Economic Analysis Staff in the Office of Water Regulations and Standards at EPA Headquarters:

401 M Street, S.W. (WH-586)
Washington, D.C. 20460
(202) 382-5397

The staff economist for this project is Harold Lester (202/382-5380).

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I. EXECUTIVE SUMMARY

We prepared a supply-demand model for the coal mining industry using published economic (market) data and BAT and BPT control cost data supplied through EPA's Effluent Guideline Division. Since the costs were only on a per-gallon basis, compliance costs were assigned to mines by relating the number of gallons of effluent per ton of coal to significant parameters (size and location). We attacked the problem of mine wetness on a stochastic basis and showed that while the results for any particular mine could not be specified with precision, the results (and thus control costs) for each region as a whole were quite reproducible. The effects within a region could be specified for the large (contract market) mines and for the small (spot market) mines.

The industry impact estimated for the BAT-2 control option (flocculant addition) results in no discernable shift of production or employment since the costs associated with BAT-2 are very small. The costs estimated for the BAT-2 control option are so small that no impact is expected in terms of mine closures, lost production, lost employment, or lost wages and salaries.

The direct effects of the BAT-4 contol option (filtration) on the industry are summarized in Table I-1. The analysis is based on the assumption that in 1984, the year of the impact, BPT control will already be in place in all cases; accordingly the table shows the changes relative to the BPT control basis. The negative impact of the BAT-4 control option is concentrated in Northern Appalachia. Under this option the region's production declines by 3%, employment by over 1600 or 4%. Production would be expected to increase in Central Appalachia and Great Plains regions. Mine closures in Northern Appalachia are estimated at just over 50 or almost 6% of the mines expected to be operating in 1984. Nationally, production and employment change little as coal production is shifted to Central Appalachia and Great Plains regions. However, the additional production in these regions would come from larger mines; the net result is a small reduction in the number of total operating mines for the nation.

The ultimate increase in the annual cost of energy to the United States consumer is about $64 MM for BAT-2 and about $332 MM for BAT-4 (1978 dollars). The effect on total coal supply and on coal reserves is negligibly small.

Our analysis also examined the potential impact of the BAT control options on metallurgical coal (both for domestic consumption and export); we found that no significant impacts in terms of production shifts are to be expected. Prices of metallurgical coal would be increased by, at most, 5% to 7% by the BAT options.

TABLE I-1

PRIMARY IMPACT SUMMARY BY REGION

CONTROL LEVEL: BAT-4

SPOT AND CONTRACT MINES

Region*	Number of Mines Opened (Closed)	Annual Production Gained (Lost) (MM Tons)	Employment Gained (Lost)	Annual Wages and Salaries Gained (Lost) ($MM)
Northern Appalachia				
BPT	955	111.23	39670	712.70
Change	(54)	(3.31)	(1610)	(21.66)
% Change	(5.7)	(3.0)	(4.1)	(3.0)
Central Appalachia				
BPT	1416	99.09	35550	598.90
Change	29	0.93	400	4.80
% Change	2.0	0.9	1.2	0.8
Southern Appalachia				
BPT	97	22.69	8410	159.60
Change	1	0	70	1.34
% Change	1.0	0	0.8	(0.8)
Great Plains				
BPT	54	304.83	32090	609.90
Change	0	3.18	360	6.81
% Change	0	1.0	1.1	1.1
National Total				
BPT	2904	836.41	175140	3200.00
Change	(24)	0.68	(780)	(8.71)
% Change	(0.8)	0.1	(0.4)	0.3

*Unimpacted regions are not shown.

II. INTRODUCTION

This report presents the economic impacts on the Coal Mining Industry of two BAT control options -- flocculant addition at the 1 ppm level and filtration. First, the data on the regulatory options is discussed; second, the economic methodology is explained; and third, the impact analysis and limitations to the analysis are examined.

Two backup appendices are also provided in separate volumes -- one is a characterization of the Coal Mining Industry and the other is a detailed description of the industry economic model developed for this assignment.

All financial figures in this report are in 1978 dollars, except where otherwise noted.

III. PROPOSED EFFLUENT LIMITATIONS

Cost information for two levels of effluent treatment[1] are shown in Figures III-I and -2, relative to "BPT" -- Lime Treatment, Aeration, and Settling:

Level 2 -- "BAT-2". BPT plus Flocculant (Acid Mines).

Level 4 -- "BAT-4". Upgraded BPT plus Filtration (Acid Mines).

We make the assumption that in 1984 all mines will be equipped with the BPT system. The economic impact of additional control of acid mines to Level 2 or Level 4 (respectively called BAT-2 and BAT-4 in this report) are evaluated.

1. (Flocculant) BAT-2 Control Costs

The incremental capital cost for a flocculant addition facility is $30,000 to $40,000. The continuing cost of flocculant, at $2/lb, depends on the effluent flow and the dosage of flocculant (ppm added). This assumes a dosage rate of 1 ppm; in this event the cited report[1] shows the costs given in Figures III-1 and -2 for BAT-2.

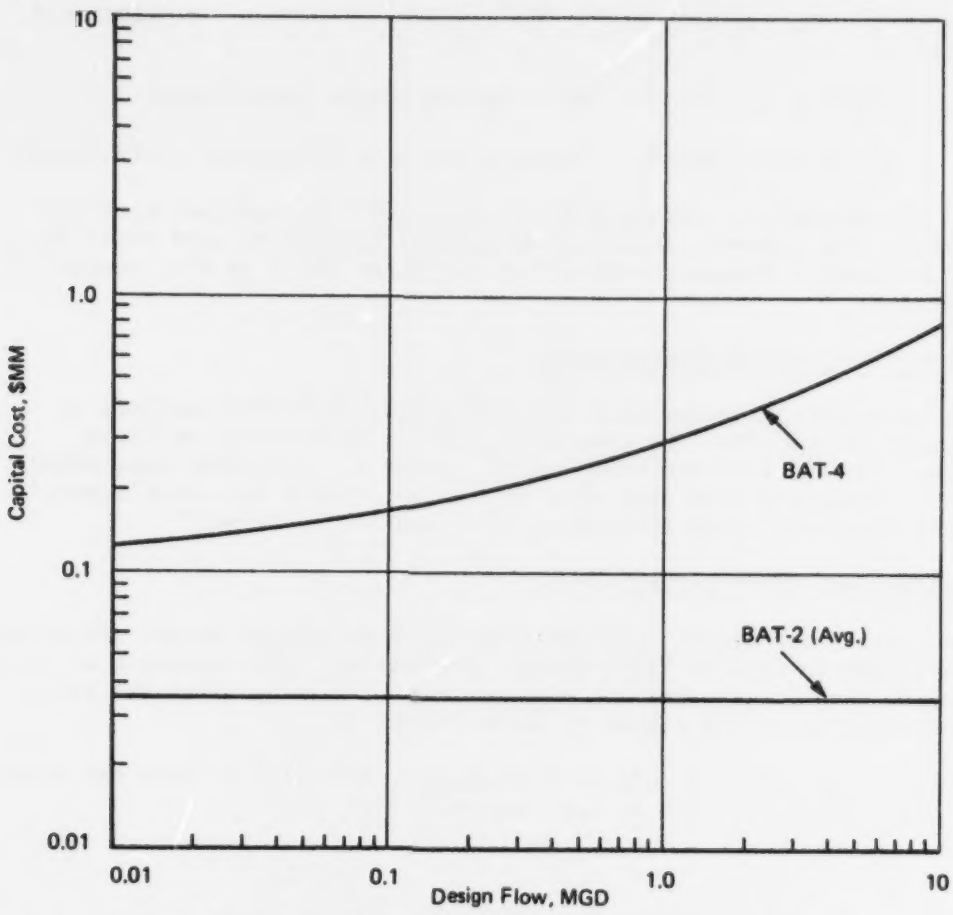
2. (Filtration) BAT-4 Control Costs

The costs [1] for adding deep-bed filtration facilities to the system are also shown in Figures III-1 and 2. The capital cost component of these figures must be adjusted for regional differences by using the factors also supplied by EPA (shown in Table III-1).

These BAT costs apply only to acid mines. Table III-2 shows the fraction of mines which are acid in each region.[1]

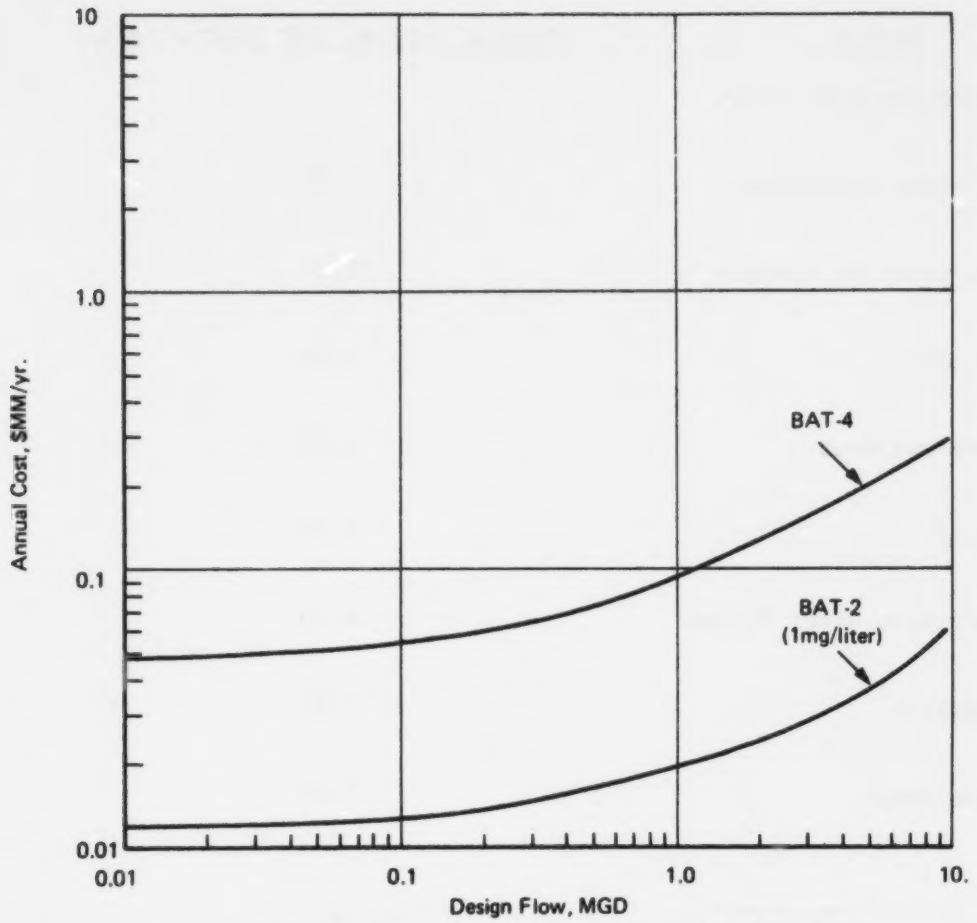
---

[1] Mine Drainage Treatment and Costing Study, Coal Mining Industry, Hydrotechnic Corporation, U.S. EPA Contract 68-02-2608, (Task 67) and 68-01-5163 (Task 03-03), Revision of October, 1979.



Source: "Mine Drainage Treatment and Costing Study, Coal Mining Industry," Hydrotechnic Corporation, USEPA Contracts 68-02-2608 (Task 67) and 68-01-5163 (Task 03-03), Revision of October, 1979.

FIGURE III–1 CAPITAL COSTS OF BAT-2 AND BAT-4 CONTROL, ACID MINES (RELATIVE TO BPT, 1979 DOLLARS)



Source: "Mine Drainage Treatment and Costing Study, Coal Mining Industry," Hydrotechnic Corporation, USEPA Contracts 68-02-2608 (Task 67) and 68-01-5163 (Task 03-03), Revision of October, 1979.

FIGURE III–2 ANNUAL COSTS OF BAT-2 AND BAT-4 CONTROL, ACID MINES (RELATIVE TO BPT, 1979 DOLLARS)

TABLE III-1

REGIONAL CAPITAL COST MULTIPLIERS

Region	Overall Capital Cost Multipliers
Northern Appalachia	1.32
Central Appalachia	1.32
Southern Appalachia	1.28
Midwest	1.12
Central West	1.08
Gulf	1.00
Northern Great Plains	1.00
Rockies	1.36
Southwest	1.26

Source: Mine Drainage Treatment and Costing Study, Coal Mining Industry, Hydrotechnic Corporation, USEPA Contracts 68-02-2608. (Task 67) and 68-01-5163 (Task 03-03), Revision of October, 1979.

TABLE III-2

PROPORTION OF ACID MINES BY REGION

Region	Surface	Underground
Northern Appalachia	21%	49%
Central Appalachia	17	17
Southern Appalachia	17	17
Midwest	25	18
Central West	16	0
Gulf	16	0
Great Plains	0	0
Rockies	0	0
Southwest	0	0

Source: Mine Drainage Treatment and Costing Study, Coal Mining Industry, Hydrotechnic Corporation, USEPA Contracts 68-02-2608, (Task 67) and 68-01-5163 (Task 03-03), Revision of October, 1979.

IV. METHODOLOGY

The economic impact of BAT regulations will depend on the magnitude of the cost increases, the proportion of coal supplies facing cost increases, the location of those coal supplies relative to other potential substitute supplies, and the quality of those potential substitute supplies. If no substitutes are available, the economic impact would be increased costs to users. If substitutes are available, the economic impact would be losses in production, jobs, wages and profits in areas of relatively higher costs, and gains in areas of lower costs, and possible substitution of coal by non-coal resources. The analysis of the economic impact of the effluent guidelines involved four distinct components:

- The availability and the mining costs of coal in the coal-supplying regions of the country.
- The cost of transporting coal from the supply regions to the demand regions.
- The costs of utilizing coals with different chemical and physical properties.
- The levels of demand for coal and the sensitivity of this demand to changes in price.

The coal mining industry was analyzed in terms of these four components and an analytical model of the industry was constructed in order to assess the levels of production, employment, wages, investment requirements, and costs of coal use in 1984 with BPT in place and with the proposed more stringent BAT effluent control options. The differences between the BPT and BAT conditions constitute the estimated impact of the BAT options.

A. Production Costs

Central to the analysis was the development of costs of production in 27 coal producing regions of the country. These regions are shown in Table IV-1.

The costs of coal mining depend on the type of mine, strip or deep; mine size; seam thickness; overburden depth; mine wetness; and others. The wide variations in the relative magnitude of these factors cause substantial variation in mining costs within regions. The fact that coal is a highly variable natural resource is reflected in a wide range of mine productivities as shown by an analysis of mine data made available by the Mine Employment and Safety Administration (MESA).*

Engineering estimates were made for technical costs of "typical" mines in each region in different size classes and for strip and deep mines. These engineering cost estimates were based on component costs which were projected to 1984 allowing for the expected changes in the costs of equipment, labor and energy as well as the changes in the average labor

* MESA's name has become the Mine Safety and Health Administration.

TABLE IV-1

COAL MODEL SUPPLY REGIONS

Model Region	
1	Pennsylvania
2	Ohio
3	Maryland
4	West Virginia, North
5	West Virginia, South
6	Virginia
7	Kentucky, East
8	Tennessee
9	Alabama
10	Illinois
11	Indiana
12	Kentucky, West
13	Iowa
14	Missouri
15	Kansas
16	Arkansas
17	Oklahoma
18	Texas
19	North Dakota
20	Montana
21	Wyoming, Powder River
22	Colorado
23	Wyoming, Other
24	Utah
25	Arizona
26	New Mexico
27	Washington

productivity. These production costs were calculated for a wide range of mine labor productivities to allow for the possible variations in mining conditions discussed above. Minimum required prices providing a minimum return on capital employed in the mining operation was calculated from these production costs.

The relationship between mine labor productivity and minimum required price, which thus had been established, provided estimates for minemouth prices for the mines which were projected to be producing in 1984. (Our projection of the future mine population used the MESA mine file as a starting point, retiring old mines and opening new mines thus simulating expected changes in regional coal mining capacity.)

The productivities for new mines were obtained through sampling of existing productivity distributions derived from the MESA mine file. Figure IV-1 shows examples of these distributions for underground and surface mines in Northern Appalachia.

The approach ensured the closest possible matching of available information on the existing mine population (from the MESA file), on expected changes in that mine population and on projected production costs obtained by engineering cost analysis.

The estimated minimum required price for each mine in the statistically generated 1984 mining population within each region formed the basis of the minimum required price for increments of coal from that region.

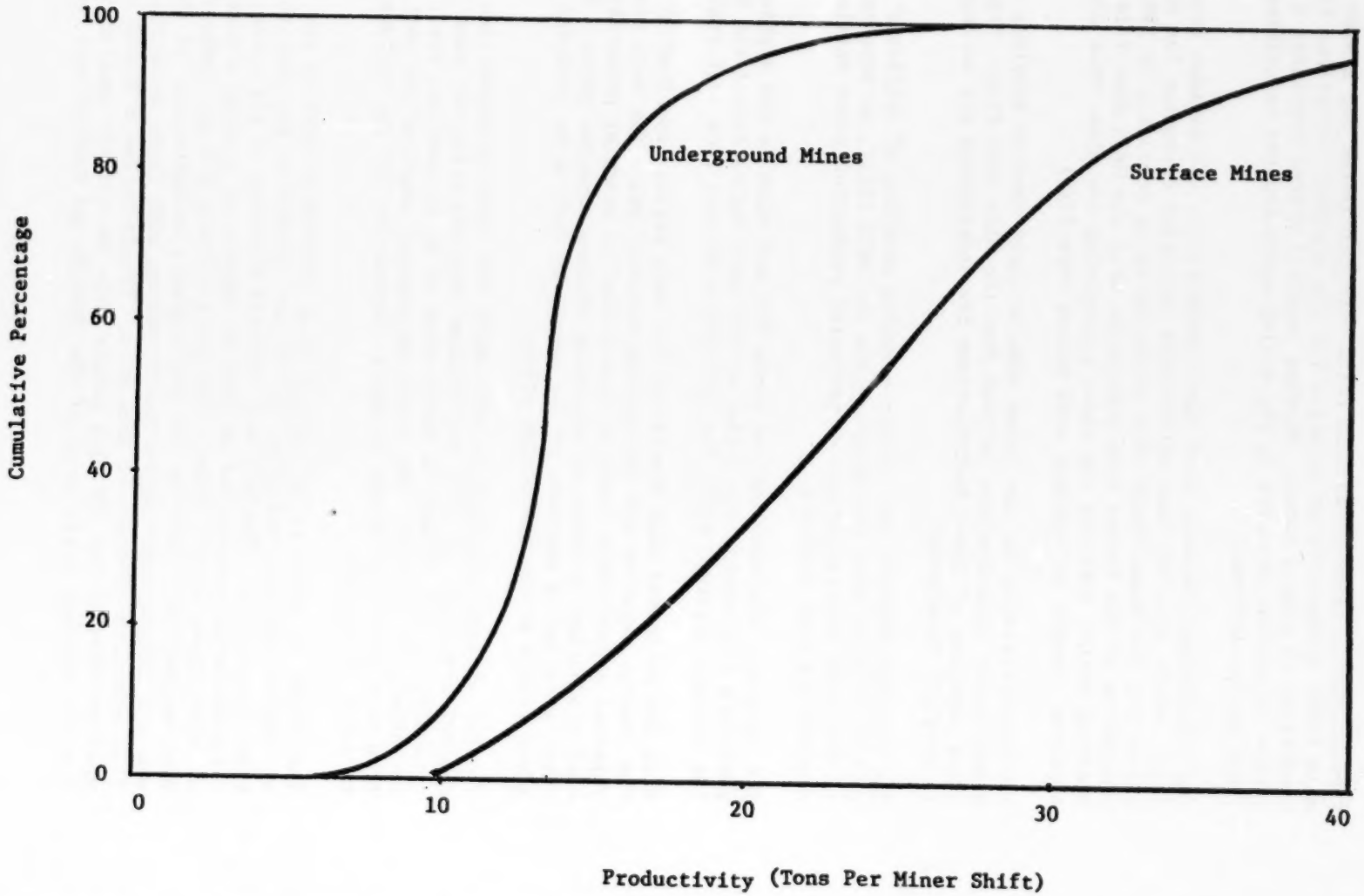
With the estimated mine population for each region described in terms of the tonnage capacity and the minimum required price for each mine, a regional supply curve could be constructed by arraying potential regional coal production in order of ascending minimum required price. This supply curve provided an estimate of the amount of coal to be produced in a given region at any particular price.

The BAT effluent limitations will shift the costs of production, the capital required, and thus the minimum required price for each acid mine depending on the volumes of waste water to be treated and the treatment technology to be used. The costs and capital required per unit of water flow were developed by the Technical Contractor for the Effluent Guidelines Division of the EPA.

The amount of water to be treated at an individual mine is the result of complex natural conditions and is not related to any particular set of mine descriptors. The Economic Analysis Division of EPA collected data from discharge permits and monitoring reports to provide a usable sample of water flows at 178 mines. Putting all these 178 data points on one plot against mine size was not particularly enlightening, as the spread was very large; there were mines reporting 1000 times as much average flow as others of the same mine size. Trends became a little clearer when one divided the 178 data points into the 111 for Appalachia, the 58 for the somewhat drier mines of the Midwest and Central West, and the 9

FIGURE IV-1

CUMULATIVE DISTRIBUTIONS OF MINE LABOR PRODUCTIVITIES
FOR UNDERGROUND AND SURFACE MINES IN NORTHERN APPALACHIA



for the much drier mines of the Great Plains and West (a more detailed subdivision would have produced too few points per category to be meaningful).

The data for each of these three subgroups are shown in Figures IV-2, -3, and -4, respectively. The scatter is still severe, but the least-squares correlation line is shown in each case, together with a pair of parallel "spread" lines which include 90% of the points. Smaller mines on the average have more gallons per ton than do larger mines of the same type in the same region.

Since, even for a given mine size, the plots show that any single mine could have a flow very different from the average, it was essential to take the large variability of water flows into account. Water flow for any individual mine in the population of mines from which the supply curves were developed was estimated by statistically sampling the distribution of flows for the appropriate mine size. As discussed in Section VI, "Limits of the Analysis", the use of sampled values for flows resulted in a more accurate estimate of the supply curves than would have been possible with the use of an average, high or low value for flows. Given the flow for each mine in the population, the BAT control cost could be allowed for in the calculation of the minimum required price, and in the deviation of regional supply curves under BAT options. These supply curves were converted to a series of steps for subsequent use; a set of supply curves for Pennsylvania is shown as an example in Figure IV-5. These supply curves were used to determine the equilibrium between regional demand and supplies with the coal market simulation models.

B. Transport Costs

Users will substitute the coal from one region for that of another if the total cost to the user is lower. Transportation costs can be a substantial portion of the total cost.

The impact analysis developed coal transportation costs from the 27 supply regions to the 35 demand regions. These transport costs were based on a sample of actual freight rates for coal from specific points in the mining regions to specific points in the demand regions. An empirical model was constructed with the transport cost per ton as a function of distance and line changes for trainload/unit train shipments and single-/multi-car shipments. These functions were used to estimate the cost of moving coal from a supply region to a demand region based on the average distance between the supply and demand region.

It is possible to move coal between a number of supply and demand regions over water; this is often a less expensive alternative. Over those supply-demand region links the cost of waterborne transport was used.

The unit cost of transport over any particular link is not affected by the effluent control costs, so that the same unit transport costs were used for the determination of BPT and BAT supply-demand equilibrium.

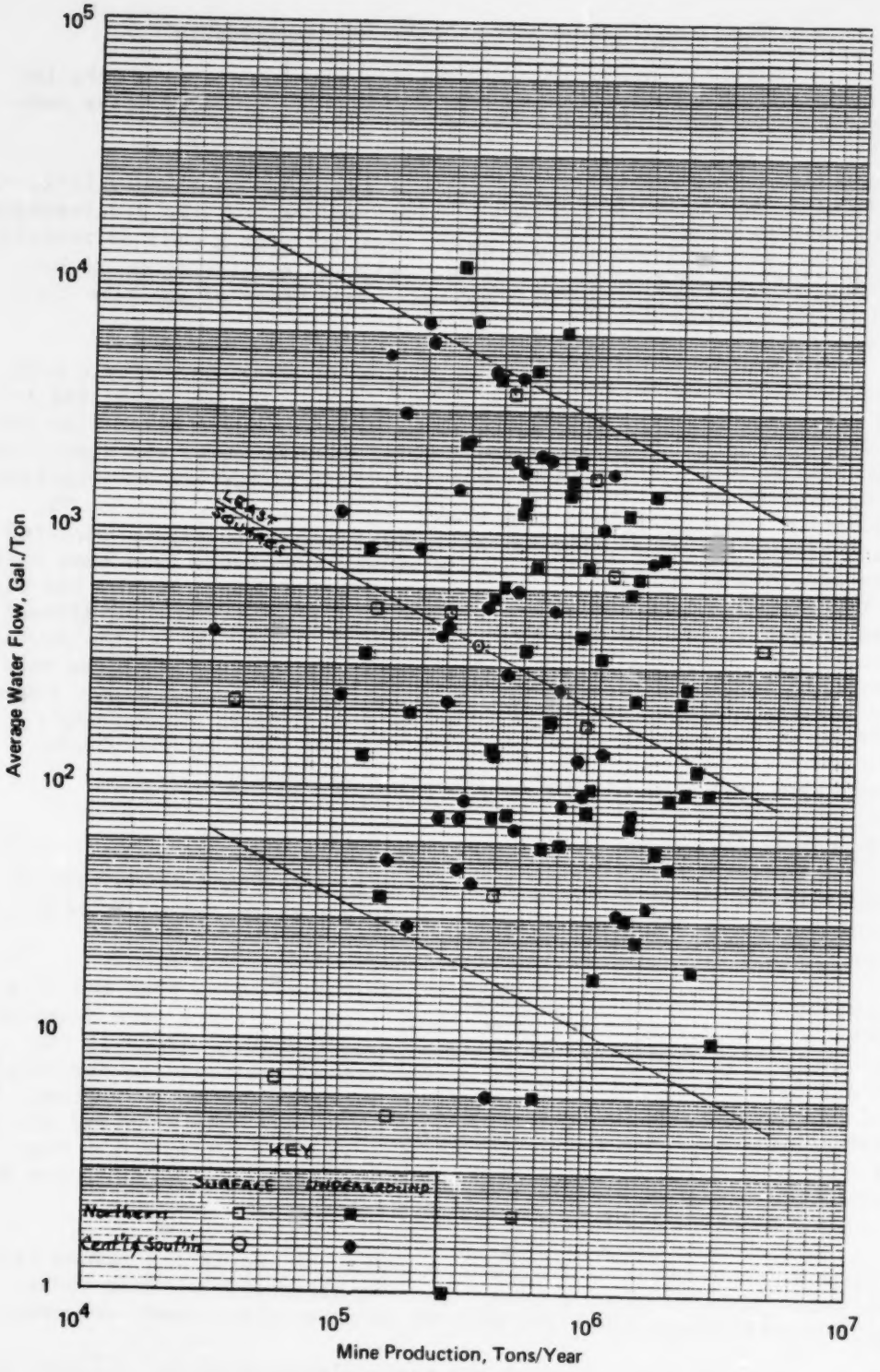


FIGURE IV–2 COAL MINE WATER FLOWS – APPALACHIA

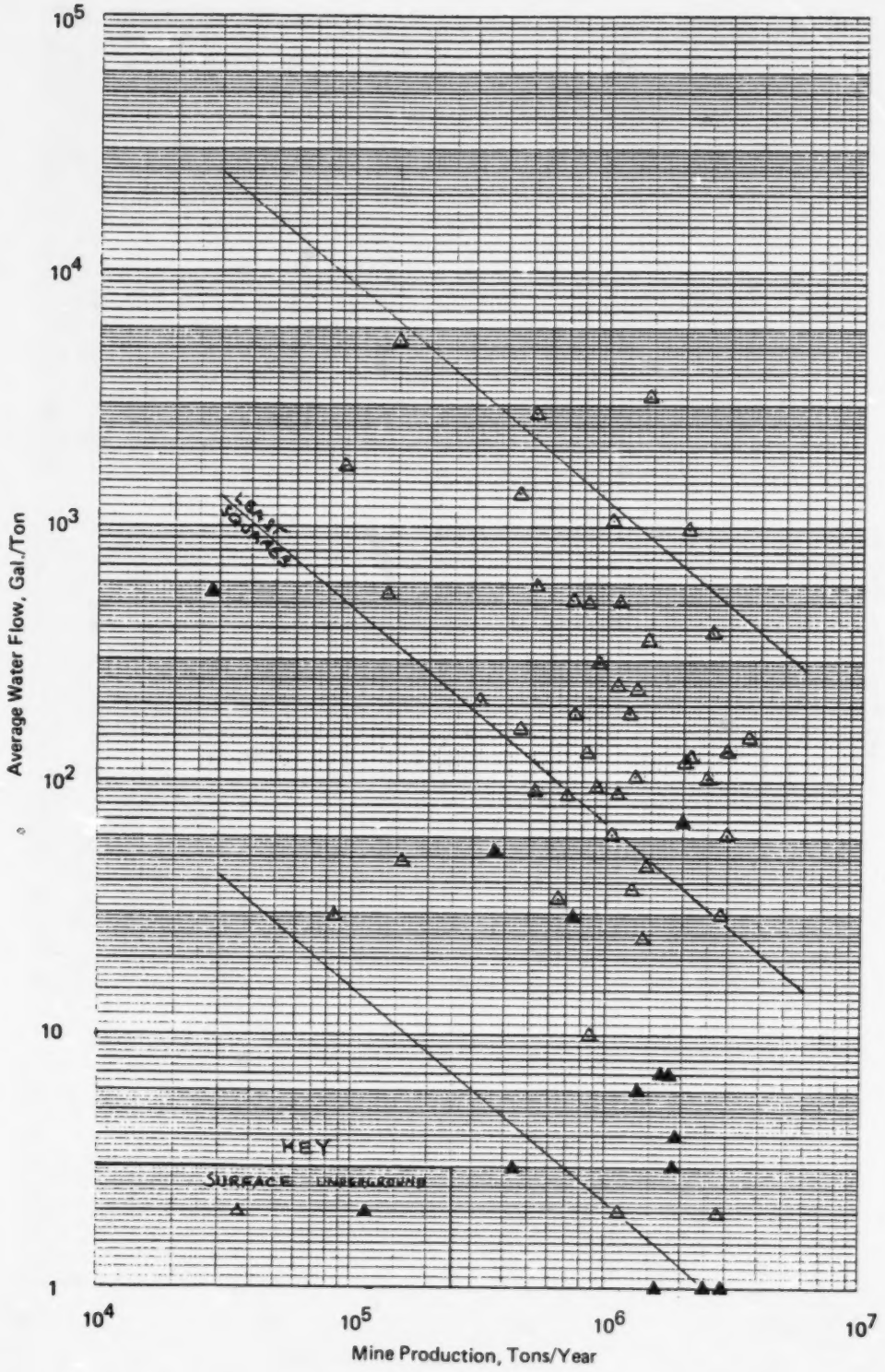


FIGURE IV–3 COAL MINE WATER FLOWS – MIDWEST AND CENTRAL WEST

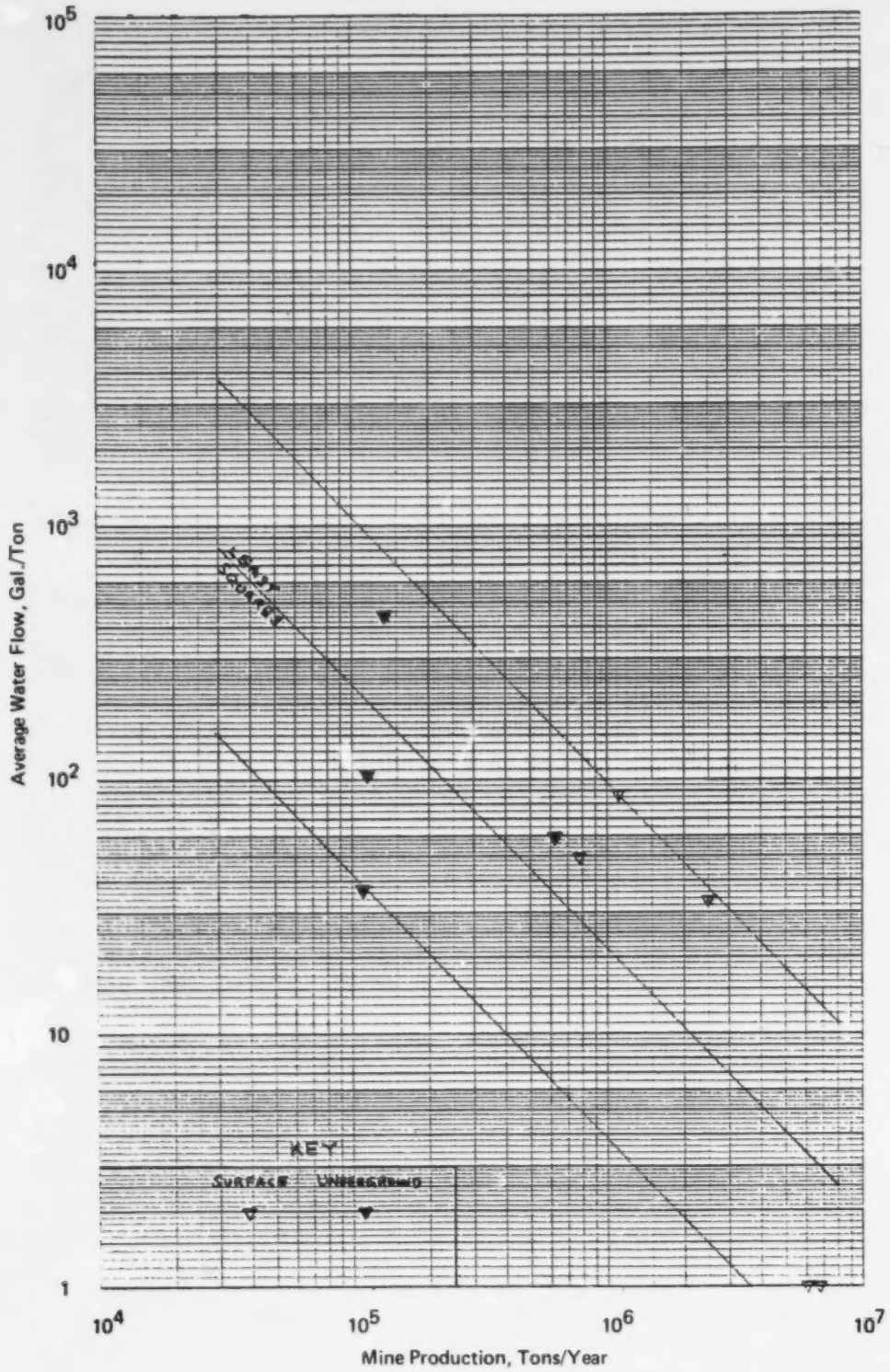


FIGURE IV–4 COAL MINE WATER FLOWS – GREAT PLAINS AND WEST

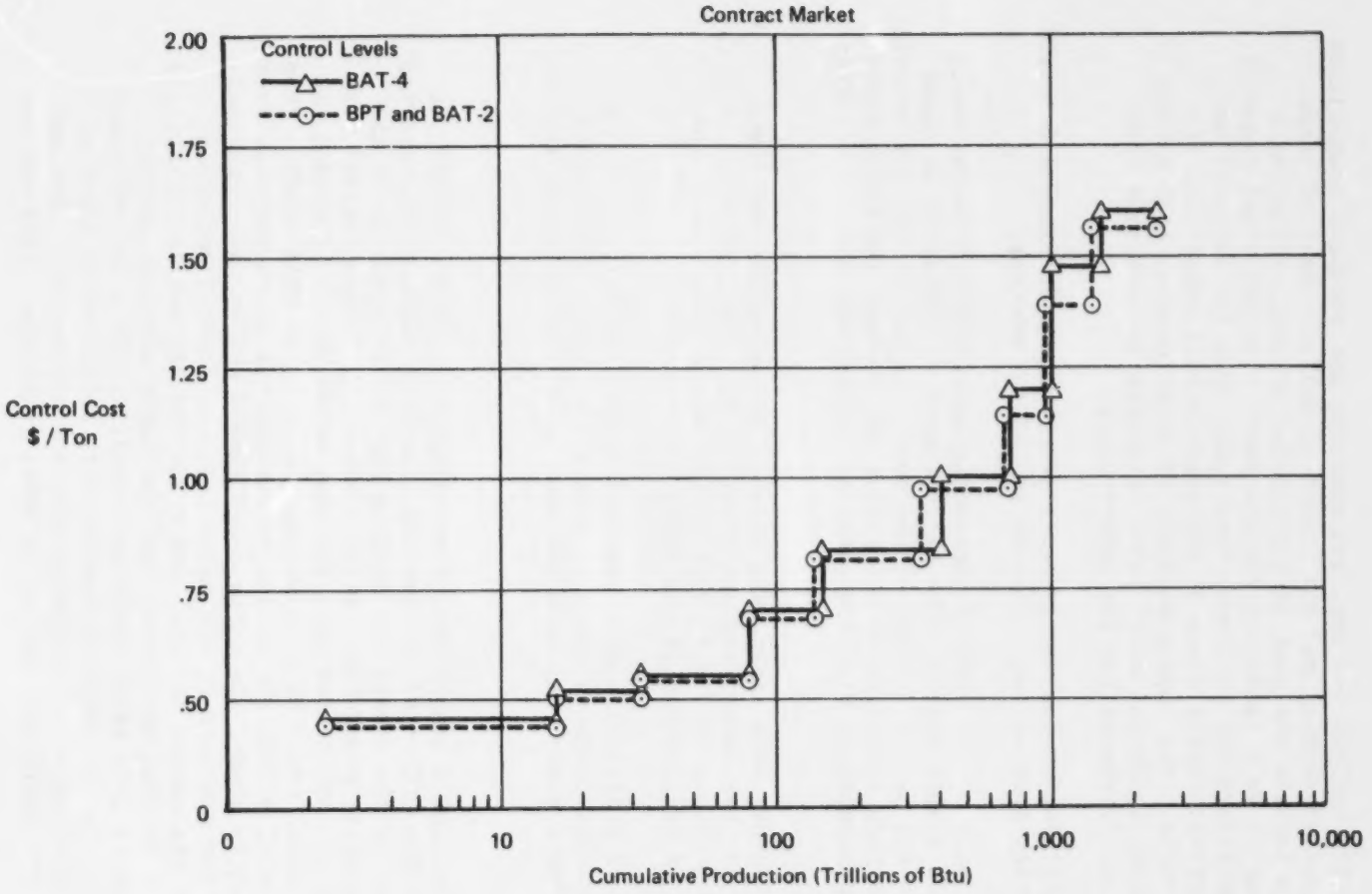


FIGURE IV–5 1984 REGIONAL COAL SUPPLY CURVE PENNSYLVANIA (1978 Dollars)

C. Utilization Costs

Coal varies by Btu content per ton, the quantity and chemical composition of ash, the moisture content and the amount of sulfur. Each of these characteristics impacts the cost of utilization of coal, either as a source of energy or as a feedstock for the basic iron and steel industry. Feedstock or metallurgical coal must have quite specific physical and chemical properties; energy coals do not constitute a substitute for metallurgical coals. The impact analysis of metallurgical coal mining was based on a supply-demand equilibrium determination separate from the supply-demand determination for energy coals.

The costs of utilization for energy coals constitute a continuous function of characteristics such as ash, moisture and sulfur content.

Estimates were made of the cost of generating electricity from the coals produced in each supply region. The major source of variation in these costs is due to the sulfur content of the coal, subject to the air emission standards which vary according to the region and whether the plant comes under State Implementation Plan Standards or Federal New Source Pollution Standards.

These various factors were taken into account in estimating the costs of utilization for the demand regions (Table IV-1). The substitution of the coal from one supply region for that of another was constrained by the relative costs of utilization of the coals.

The unit costs of utilization of a particular coal are not affected by the effluent control costs so the unit utilization costs within each demand region for a given coal were the same under BPT or BAT conditions.

D. Demand

In order to determine a supply-demand equilibrium, demand must also be estimated. The EPA Office of Air Quality Standards has recently carried out a projection of the demand for coal as part of an analysis of the impact of air quality standards. After evaluation, it was decided that the projections of coal demand made for that study were as thorough and as good as any which could be made within the scope of this study. Thus the demand for coal within the 35 demand regions was taken directly from the EPA air quality study. By using these demand projections, the coal demand used in the analysis of the water effluent control options is consistent with the demand for coal under the EPA air quality guidelines. We thus made the initial assumption that the water effluent control options analyzed in this study would not significantly alter the total demand for coal. If the costs of control were sufficiently large to make such substitution of other energy supplies appropriate, then new demand projections would have had to be made; fortunately this was not necessary.

The supply-demand equilibrium was determined by a linear program which minimizes the total cost of meeting the demand for energy from coal. The linear program estimates the total cost of providing energy from coal in each of the demand regions. It also determines the regions from which that coal will be supplied based on the FOB coal price, the costs of transportation, and costs of utilizing the coals of different supply regions in each demand region.

The supply-demand equilibrium was determined for the BPT and BAT supply-demand scenarios. The difference between the BPT and BAT solutions constituted the estimated economic impact of the BAT effluent limitations. These impacts were estimated in terms of the increased costs borne by consumers for energy or for iron and steel products. The impacts on suppliers were estimated in terms of shifts in production, employment, wages, and investment requirements. Some of these primary impacts were shown to potentially result in a shift of general economic conditions in coal producing regions; these secondary impacts were also analyzed.

V. ECONOMIC IMPACTS

The economic impacts of the BAT control options result from the establishment of a new market equilibrium under the altered mining costs required to meet the BAT effluent standards. The new equilibrium may alter the prices at which coal will be supplied, the amounts of coal supplied from the various production regions, the levels of regional employment (impacting, in turn, the general regional levels of economic activity), and the amounts of cash generation and investment required in the coal mining industry. The alterations constituting the economic impact are from the baseline estimates of activity which presume that coal mining in 1984 will already have BPT control technology in place.

The analysis of economic impact separates the coal mining industry into three components; energy coal contract market mines, energy coal spot market mines, and metallurgical coal mines. These three components are basically separate, although there is some interaction between contract and spot market mines, and the market equilibria for these three components are derived separately.

A. Price Effects

The BAT control options result in mining costs higher than those under BPT control levels for all acid mines with significant water flows. The variability of water flow among individual mines means that some mines will face very low or even zero control costs while others will face relatively high control costs due to high and acidic water flows.

These control costs vary by mine and result in an upward shift in the supply curve and a change of shape in the supply curve for various regions. The amount of upward shift can be demonstrated by a comparison of the base and the BAT control option minimum required prices (costs of production plus a minimum required return -- 10% on capital) for the final ton of coal supplied under the BPT case ("marginal" price). This comparison is shown in Tables V-1 through -3 for the three classes of mines. It must be borne in mind that these are not the prices to be realized under the BAT control option equilibria, but only a measure of the production cost shift brought about the BAT control options. The mining costs shown for the various control options cover production costs and the costs of control of mining effluents.

It will be noted from Table V-1 that these shifts vary by region indicating the regional variation of water flows, water acidity, and mine sizes. The general level of cost increase under BAT-2 is on the order of 0.1 percent in Northern and Central Appalachia, while western regions face no control costs since those regions have been estimated to have alkaline water flows. Costs for BAT-4 are higher in Northern Appalachia due to the costs associated with treating the acid mine effluent in those regions.

TABLE V-1

1984 PRIMARY IMPACT SUMMARY

MARGINAL COAL COSTS

CONTRACT MARKET MINES

Area	Region		BPT $/Ton	BAT-2(1) $/Ton	BAT-2(1) % Change	BAT-4(1) $/Ton	BAT-4(1) % Change
Northern Appalachia	1	PA	31.37	31.39	0.1	32.52	3.7
	2	OH	25.71	25.68	-0.1	26.83	4.4
	3	MD	33.16	33.16	0.0	33.43	0.8
	4	WV(N)	24.46	24.46	0.0	24.62	0.7
Central Appalachia	5	WV(S)	29.69	29.68	0.0	30.05	1.2
	6	VA	27.24	27.25	0.0	27.46	0.8
	7	KY(E)	23.32	23.17	-0.6	23.39	0.3
	8	TN	32.28	32.28	0.0	32.39	0.3
Southern Appalachia	9	AL	29.26	29.26	0.0	30.96	5.8
Midwest	10	IL	20.05	20.03	-0.1	20.14	0.4
	11	IN	19.09	19.08	-0.1	19.27	0.9
	12	KY(W)	23.09	23.09	0.0	23.19	0.4
	13	LA	7.31	7.31	0.0	7.40	1.2
Central West	14	MO	12.94	12.92	-0.2	13.00	0.5
	15	KS	7.01	7.00	-0.1	7.09	1.1
	16	AR	7.15	7.15	0.0	7.24	1.3
	17	OK	17.46	17.45	-0.1	17.63	1.0
Gulf	18	TX	12.40	12.40	0.0	12.43	0.2
Great Plains	19	ND	8.56	8.56	0.0	8.56	0.0
	20	SD	-	-	-	-	-
	21	WY(P)	-	-	-	-	-
	22	MT	10.22	10.22	0.0	10.22	0.0
Rockies	23	WY(O)	-	-	-	-	-
	24	CO(N)	-	-	-	-	-
	25	CO(S)	16.26	16.26	0.0	16.26	0.0
	26	UT	22.15	22.15	0.0	22.15	0.0
Southwest	27	AZ	14.20	14.20	0.0	14.20	0.0
	28	NM	9.63	9.63	0.0	9.63	0.0
Northwest	29	WA	13.60	13.60	0.0	13.60	0.0

(1) BAT-2 and BAT-4 affect the marginal costs for acid mines only.

TABLE V-2

1984 PRIMARY IMPACT SUMMARY

MARGINAL COAL COSTS

SPOT MARKET MINES

Area	Region		BPT	BAT-2(1)		BAT-4(1)	
			$/Ton	$/Ton	% Change	$/Ton	% Change
Northern Appalachia	1	PA	28.83	28.46	-1.3	29.82	3.4
	2	OH	24.35	24.50	0.6	26.78	10.0
	3	MD	16.94	17.13	1.1	20.84	23.0
	4	WV(N)	24.10	25.75	6.8	25.59	6.2
Central Appalachia	5	WV(S)	38.67	38.53	-0.4	40.48	4.7
	6	VA	30.45	30.50	0.2	30.42	-0.1
	7	KY(E)	24.95	25.22	1.1	28.84	15.6
	8	TN	29.00	28.34	-2.3	31.04	7.0
Southern Appalachia	9	AL	11.63	11.68	0.4	13.31	14.4
Midwest	10	IL	32.29	32.28	0.0	32.37	0.2
	11	IN	18.44	18.57	0.7	20.88	13.2
	12	KY(W)	17.33	17.46	0.8	19.77	14.1
	13	LA	-	-	-	-	-
Central West	14	MO	-	-	-	-	-
	15	KS	-	-	-	-	-
	16	AR	-	-	-	-	-
	17	OK	28.01	28.22	0.7	30.86	10.2
Gulf	18	TX	-	-	-	-	-
Great Plains	19	ND	-	-	-	-	-
	20	SD	-	-	-	-	-
	21	WY(P)	*	*	*	*	*
	22	MT	-	-	-	-	-
Rockies	23	WY(O)	-	-	-	-	-
	24	CO(N)	-	-	-	-	-
	25	CO(S)	22.37	22.37	0	22.37	0
	26	UT	-	-	-	-	-
Southwest	27	AZ	-	-	-	-	-
	28	NM	-	-	-	-	-
Northwest	29	WA	-	-	-	-	-

* Spot market coal is provided by surplus contract market mine production.

(1) BAT-2 and BAT-4 affect the marginal costs for acid mines only.

TABLE V-3

1984 PRIMARY IMPACT SUMMARY

MARGINAL COAL COSTS

METALLURGICAL COAL MINES

Area	Region		BPT $/Ton	BAT-2 (1) $/Ton	BAT-2 (1) % Change	BAT-4 (1) $/Ton	BAT-4 (1) % Change
Northern Appalachia	1	PA	50.47	<51.97	<3.0	<53.44	<5.9
	2	OH	-	-	-	-	-
	3	MD	-	-	-	-	-
	4	WV(N)	-	-	-	-	-
Central Appalachia	5	WV(S)	-	-	-	-	-
	6	VA	54.96	<59.16	<7.6	<57.37	<4.4
	7	KY(E)	46.89	<49.87	<6.4	<48.76	<4.0
	8	TN	40.43	<43.98	<8.8	<41.34	<2.3
Southern Appalachia	9	AL	52.67	<54.28	<3.1	<54.01	<2.5
Midwest	10	IL	43.30	<48.51	<12.0	<52.23	<20.6
	11	IN	-	-	-	-	-
	12	KY(W)	-	<37.52	-	<35.82	-
	13	LA	-	-	-	-	-
Central West	14	MO	0	0	0	0	0
	15	KS	0	0	0	0	0
	16	AR	0	0	0	0	0
	17	OK	0	0	0	0	0
Gulf	18	TX	0	0	0	0	0
Great Plains	19	ND	0	0	0	0	0
	20	SD	0	0	0	0	0
	21	WY(P)	0	0	0	0	0
	22	MT	0	0	0	0	0
Rockies	23	WY(O)	-	-	0	0	0
	24	CO(N)	-	-	-	-	-
	25	CO(S)	40.74	<42.40	<4.1	<41.20	<1.1
	26	UT	36.51	<37.69	<3.2	<36.45	<-0.2
Southwest	27	AZ	0	0	0	0	0
	28	NM	0	0	0	0	0
Northwest	29	WA	0	0	0	0	0

(1) BAT-2 and BAT-4 affect the marginal costs for acid mines only.

Table V-2 shows the substantially larger cost increases for spot market mines; these are small mines (less than 50,000 tons per year), and the water flows per ton are larger than for the larger contract market mines. Metallurgical coal mines (Table V-3) exhibit relatively moderate percentage cost increases largely due to the higher base costs of metallurgical coal.

The small cost shifts under each of the control options indicate the basic magnitude to be expected in impact parameters.

At this point, the special nature of metallurgical coal must be considered. Metallurgical coal constitutes a resource separate from energy coals since energy coals are not a viable substitute in making coke. However, beyond that there are very limited possiblities of substitution between metallurgical coals. Their different chemical and physical properties mean that the metallurgical coal from one region often cannot be substituted for coals from other regions and in many cases, the production of coke requires a blend of metallurgical coals to provide an appropriate feedstock. The metallurgical coal resource base is also limited; as can be seen relatively few coal-producing regions produce metallurgical coal.

Given the above, the limited nature of the resource base, and the moderate and relatively consistent mining cost increases expected from the two BAT control options, no measurable shifts of production are expected. The economic impact will be in the form of increased prices for metallurgical coal; the demand for metallurgical coal is price inelastic due to the lack of substitute feedstocks for basic iron and steel production. Exports also constitute a significant source of demand and no significant alteration of demand is expected due to the small price changes due to either of the control options. The cost increases shown in Table V-3 overstate the impact from BAT-2 and BAT-4 as presently structured since those costs are based on an earlier more stringent version of those control options. Since these higher costs were not expected to generate any production shifts, it was decided not to recreate the metallurgical coal supply curves under the lower control cost options.

The shifts in the supply curves in coal-producing regions will result in a new market equilibrium as coal users seek substitute coals. The equilibria under the BAT control options will provide coal energy to the nation as a whole at the minimum total cost. That total cost accounts for not only the cost of mining the coal, but also the cost of transportation and utilizing coals of differing quality as discussed in Section IV above. The shift of the amount of coal provided by a region means a movement along the region's supply curves. Under the equilibria of the BAT control options, prices of coal can vary not only because of increased costs of production due to effluent control costs, but also because regions can produce quantities of coal different from those provided under the BPT market equilibrium. These shifts result in equilibrium coal prices different from those shown in Tables V-1 and -2. The equilibrium coal prices based on the expected quantities supplied from each region are shown in Tables V-4 and -5. These equilibrium prices under BAT control options and the changes of those prices from the BPT equilibrium prices constitute the expected price impact due to the regulations. These prices are based on the linear approximations of the supply curves used by the market

TABLE V-4

1984 PRIMARY IMPACT SUMMARY
EQUILIBRIUM COAL MINING COST SHIFT
CONTRACT MARKET MINES

Area	Region		BPT $/Ton	BAT-2 $/Ton	BAT-2 % Change	BAT-4 $/Ton	BAT-4 % Change
Northern Appalachia	1	PA	31.46	31.46	0.0	31.91	1.4
	2	OH	27.10	27.12	0.1	27.41	1.1
	3	MD	33.06	33.29	0.7	33.94	2.7
	4	WV(N)	27.42	27.44	0.1	27.72	1.1
Central Appalachia	5	WV(S)	30.89	30.91	0.1	31.17	0.9
	6	VA	32.48	32.50	0.1	32.53	0.2
	7	KY(E)	27.71	27.73	0.1	27.75	0.1
	8	TN	35.98	36.00	0.1	36.03	0.1
Southern Appalachia	9	AL	31.52	31.52	0	31.52	0
Midwest	10	IL	23.18	23.18	0	23.18	0
	11	IN	23.82	23.82	0	23.82	0
	12	KY(W)	23.37	23.37	0	23.37	0
	13	LA	15.05	15.02	0	15.02	0
Central West	14	MO	16.58	16.58	0	16.58	0
	15	KS	19.65	19.65	0	19.65	0
	16	AR	20.21	20.21	0	7.13	-64.7
	17	OK	26.46	26.46	0	26.46	0
Gulf	18	TX	12.93	12.93	0	12.93	0
Great Plains	19	ND	8.61	8.61	0	8.61	0
	20	SD	-	-	-	-	-
	21	WY(P)	7.94	7.94	0	7.94	0
	22	MT	8.58	8.58	0	8.58	0
Rockies	23	WY(O)	13.28	13.28	0	13.28	0
	24	CO(N)	-	-	-	-	-
	25	CO(S)	18.25	18.25	0	18.25	0
	26	UT	22.08	22.08	0	22.08	0
Southwest	27	AZ	14.15	14.15	0	14.15	0
	28	NM	13.34	13.34	0	13.34	0
Northwest	29	WA	13.56	13.56	0	13.56	0

TABLE V-5

1984 PRIMARY IMPACT SUMMARY
EQUILIBRIUM COAL MINING COST SHIFT
SPOT MARKET MINES

Area	Region		BPT $/Ton	BAT-2 $/Ton	BAT-2 % Change	BAT-4 $/Ton	BAT-4 % Change
Northern Appalachia	1	PA	25.08	22.80	-9.1	25.08	0
	2	OH	20.52	20.52	0	18.92	-7.8
	3	MD	16.87	17.10	0	20.75	23.0
	4	WV(N)	24.01	24.50	2.0	24.50	2.0
Central Appalachia	5	WV(S)	38.76	38.76	0	41.04	5.9
	6	VA	31.07	31.07	0	31.07	0
	7	KY(E)	25.85	25.85	0	28.20	9.1
	8	TN	28.20	28.20	0	30.55	8.3
Southern Appalachia	9	AL	11.65	11.65	0	13.28	14.0
Midwest	10	IL	27.26	27.26	0	27.26	0
	11	IN	13.93	13.93	0	15.65	12.3
	12	KY(W)	17.35	17.35	0	19.80	14.1
	13	LA	0	0	0	0	0
Central West	14	MO	0	0	0	0	0
	15	KS	0	0	0	0	0
	16	AR	0	0	0	0	0
	17	OK	22.33	22.33	0	30.56	36.9
Gulf	18	TX	0	0	0	0	0
Great Plains	19	ND	0	0	0	0	0
	20	SD	0	0	0	0	0
	21	WY(P)	0	0	0	0	0
	22	MT	0	0	0	0	0
Rockies	23	WY(O)	0	0	0	0	0
	24	CO(N)	0	0	0	0	0
	25	CO(S)	22.87	22.87	0	22.87	0
	26	UT	0	0	0	0	0
Southwest	27	AZ	0	0	0	0	0
	28	NM	0	0	0	0	0
Northwest	29	WA	0	0	0	0	0

equilibrium model and are not strictly comparable with the prices in Tables V-1 and-2. These are the prices which would be received for the next additional ton of coal produced from the region. The region does not produce an additional unit of coal because the next unit of coal from the region is in fact estimated to have a minimum required price greater than the price in Tables V-4 and -5. (It will be noted that there are some regions which exhibit "jumps" in the price. These jumps are anomalies in regions where all the coal available is being used so that production is limited by resources, not by the next economically available unit of coal. In these cases, a small change in alternative supplies can lead to large jumps in prices. It will also be noted that the regions where these jumps occur are not significant coal-producing regions.)

The prices received by contract market mines under BAT-2 are generally expected to increase by only about 0.1% in Northern and Central Appalachia. Under BAT-4 prices are expected to increase by up to 2.7% in Maryland, but generally by less than 1.5% in the remainder of Northern Appalachia, under 1.0% in Central Appalachia and no change expected in other regions. (The Arkansas decline is an anomaly).

The equilibrium prices also show that coal prices in various regions do not rise as much as control costs, indicating that there will be mines whose costs will have risen by more than the change in market price. These mines will be no longer economically viable under the BAT-4 control option.

The equilibrium prices shown for spot market mines actually show a decline in one region under each control option. These declines are due to the shifts in the linear estimates of the supply curves and the accuracy with which those estimates are made from the supply curves.

B. Production Effects

The establishment of new market equilibria under the BAT control options results in production shifts with respect to the BPT base case. Tables V-6 through -8 show the expected 1984 levels of production in each coal-producing region under the BPT and BAT control option equilibria. The tables show the impact on contract market mines, spot market mines, and the aggregate impact. No production impacts are shown for metallurgical coal mines because the entire economic impact of the BAT control options is expected to be in the form of increased prices with no shifts in production.

Table V-6 shows that for contract mines under BAT-2, there is no measurable production shift. The cost increases estimated for BAT-2 control are very small for all regions so that the competitive relation of coals is not shifted.

Under BAT-4, the production shifts are expected to result in a decline of Pennslyvania production and an increase in Wyoming Powder River production. There are also some minor production shifts in other Appalachian regions. The control costs faced by Pennsylvania are expected to be large

TABLE V-6

1984 PRIMARY IMPACT SUMMARY

COAL PRODUCTION BY REGION

CONTRACT MARKET MINES

(MM Tons/Year)

Area	Region		MMTPY BPT	BAT-2 MMTPY	BAT-2 GAIN (LOSS)	BAT-4 MMPTY	BAT-4 GAIN (LOSS)
Northern Appalachia	1	PA	47.98	47.98	0	45.10	(2.88)
	2	OH	31.20	31.20	0	31.60	.40
	3	MD	3.70	3.70	0	3.70	0
	4	WV(N)	17.20	17.20	0	17.20	0
			100.08	100.08		97.60	-2.48
Central Appalachia	5	WV(S)	26.20	26.20	0	26.40	.20
	6	VA	14.20	14.20	0	14.50	.30
	7	KY(E)	35.80	35.80	0	35.80	0
	8	TN	4.00	4.00	0	4.00	0
			80.20	80.20		80.70	.50
Southern Appalachia	9	AL	22.60	22.60	0	22.70	.10
Midwest	10	IL	41.40	41.40	0	41.40	0
	11	IN	37.50	37.50	0	37.50	0
	12	KY(W)	40.90	40.90	0	40.90	0
	13	LA	0.40	0.40	0	0.40	0
			120.20	120.20		120.20	
Central West	14	MO	4.60	4.60	0	4.60	0
	15	KS	0.40	0.40	0	0.40	0
	16	AR	0.50	0.50	0	0.50	0
	17	OK	4.60	4.60	0	4.60	0
			10.10	10.10		10.10	
Gulf	18	TX	17.70	17.70	0	17.70	0
Great Plains	19	ND	27.53	27.53	0	27.53	0
	20	SD	0.0	0.0	0	0.0	0
	21	WY(P)	201.40	201.40	0	204.15	2.75
	22	MT	75.90	76.36	.46	76.36	.46
			304.83	305.29		308.04	3.21
Rockies	23	WY(O)	57.30	57.30	0	57.30	0
	24	CO(N)	0.0	0.0	0	0.0	0
	25	CO(S)	14.90	14.90	0	14.90	0
	26	UT	0.33	0.00	(.33)	0.0	(.33)
			72.53	72.20	(.33)	72.20	(.33)
Southwest	27	AZ	12.49	12.49	0	12.49	0
	28	NM	8.00	8.00	0	8.00	0
			20.49	20.49		20.49	
Northwest	29	WA	7.63	7.63	0	7.63	0
Total			756.36	756.49	.13	757.36	1.00

(1) WY(P) is Wyoming Powder River Basin; WY(O) is Wyoming, Other Areas

TABLE V-7
1984 PRIMARY IMPACT SUMMARY
COAL PRODUCTION BY REGION

SPOT MARKET MINES
(MM Tons/Year)

Area	Region		MMTPY BPT	BAT-2 MMTPY	BAT-2 GAIN (LOSS)	BAT-4 MMPTY	BAT-4 GAIN (LOSS)
Northern Appalachia	1	PA	7.25	7.25	0	6.81	(0.44)
	2	OH	1.84	1.84	0	1.41	(0.43)
	3	MD	0.27	0.27	0	0.31	0.04
	4	WV(N)	1.79	1.79	0	1.79	0
			11.15	11.15	0	10.32	(-.83)
Central Appalachia	5	WV(S)	6.13	6.13	0	6.13	0
	6	VA	4.98	4.98	0	4.98	0
	7	KY(E)	6.15	6.15	0	6.58	0.43
	8	TN	1.63	1.63		1.63	0
			18.89	18.89	0	19.32	0.43
Southern Appalachia	9	AL	0.09	0.09	0	0.09	0
Midwest	10	IL	48.43	48.43	0	48.43	0
	11	IN	0.16	0.16	0	0.16	0
	12	KY(W)	0.52	0.52	0	0.52	0
	13	LA	-				
			49.11	49.11	0	49.11	
Central West	14	MO	-	-	-	-	-
	15	KS	-	-	-	-	-
	16	AR	-	-	-	-	-
	17	OK	0.33	0.33	0	0.41	0.08
Gulf	18	TX	-	-	-	-	-
			-	-	-	-	-
	19	ND	-	-	-	-	-
Great Plains	20	SD					
	21	WY(P)[1]	-	-	-	-	-
	22	MT	-	-	-	-	-
Rockies	23	WY(O)[1]	*	*	-	*	-
	24	CO(N)	-	-	-	-	-
	25	CO(S)	0.48	0.48	0	0.48	0
	26	UT	-	-	-	-	-
Southwest	27	AZ	-	-	-	-	-
	28	NM	-	-	-	-	-
Northwest	29	WA	-	-	-	-	-
Total			80.05	80.05	0	79.73	(.48)

WY(P) is Wyoming Powder River Basin; WY(O) is Wyoming, Other Areas
Less than 0.005

TABLE V-8

1984 PRIMARY IMPACT SUMMARY

PRODUCTION CHANGES FROM BPT

SPOT AND CONTRACT MARKET MINES

Region	State		BAT-2 GAIN (LOSS) (MMTONS)	BAT-2 GAIN (LOSS) (%)	BAT-4 GAIN (LOSS) (MMTONS)	BAT-4 GAIN (LOSS) (%)
Northern Appalachia	1	PA	0	0	(3.32)	(6.0)
	2	OH	0	0	(.03)	(0.1)
	3	MD	0	0	.04	(1.0)
	4	WV(N)	0	0	0	0
			0	0	(3.31)	(3.0)
Central Appalachia	5	WV(S)	0	0	.20	0.6
	6	VA	0	0	.30	1.6
	7	KY(E)	0	0	.43	1.0
	8	TN	0	0	0	0
			0	0	.93	0.9
Southern Appalachia	9	AL	0	0	.10	0.4
Midwest	10	IL	0	0	0	0
	11	IN	0	0	0	0
	12	KY(W)	0	0	0	0
	13	LA	0	0	0	0
			0	0	0	0
Central West	14	MO	0	0	0	0
	15	KS	0	0	0	0
	16	AR	0	0	0	0
	17	OK	0	0	.08	1.6
			0	0	.08	0.8
Gulf	18	TX	0	0	0	0
Great Plains	19	ND	0	0	0	0
	20	SD	-	-	-	-
	21	WY(P)	0	0	2.75	1.4
	22	MT	0.46	(0.6)	.46	0.6
			0.46	0.2	3.21	1.1
Rockies	23	WY(O)	0	0	0	0
	24	CO(N)	-	-	-	-
	25	CO(S)	0	0	0	0
	26	UT	(.33)	(100.0)	(.33)	(100.0)
			(.33)	(0.5)	(.33)	(0.5)
Southwest	27	AZ	0	0	0	0
	28	NM	0	0	0	0
Northwest	29	WA	0	0	0	0
			.13	*	.68	0.1

*Less than 0.05%

enough to shift relative production costs of Pennsylvania vis-a-vis other regions to overcome the higher transport costs of Wyoming coals.

Table V-7 presents the expected levels of production under the three cases for spot market mines. Northern Appalachia coal production would be expected to be reduced and production in Central Appalachia to be increased. This shift is due to the higher cost increases faced by Appalachian mines due to the generally larger acidic water flows requiring treatment.

Table V-8 summarizes the impact for both contract and spot market mines by showing the expected production shifts under the two BAT control options in both tonnage and percentage terms relative to the BPT case. The percentage shifts show that the production impact on some regions of the control options is expected to be moderate. The 6 percent reduction of production in Pennslyvania under BAT-4 is the only significant shift. As the table shows, the production lost is balanced by production gains in other regions. In terms of production effects, no significant impact can be seen for the nation as a whole.

The shifts in production will result in the closing of mines in some regions and the opening of new mines in other regions. Tables V-9 through -11 show the numbers of mines expected to be in operation under BPT and the two BAT control options. The impact in terms of mine closures is concentrated in the areas where production losses were concentrated, but mine closures in Appalachia are not balanced with an equal number of mine openings in other areas. This lack of balance is due to the larger mining units in the Northern Great Plains where production is expanded. The net result is that under BAT-4, the total population of mines would be reduced with the largest reduction in spot market mines. Spot market mines have by far the largest closure rate due to the high proportion of small wet mines in the population. Water treatment costs are a higher portion of BPT mining costs for these mines because small mines must treat higher flows per ton of coal produced, but are unable to gain any benefit from economies of scale in water treatment facilities.

Table V-11 presents the levels of mine closures and openings under the two BAT control options for contract and spot market mines combined. The mine population shifts are shown as the absolute change in operating mines and as the percentage change from the BPT base case population. The impact in terms of mine closures is concentrated in Northern Appalachian areas, where under BAT, at a maximum, 10% of the mines estimated to be operating under BPT are closed. These closures are counterbalanced by increased mining operations in Central Appalachia.

One of the impacts of the regulations is to increase the economic advantages of large mines over smaller mines. This advantage is due to the phenomenon of generally higher water flows per ton for smaller mines resulting in higher per-ton control costs under either control option, and the concen-

TABLE V-9

1984 PRIMARY IMPACT SUMMARY
NUMBER OF CONTRACT MARKET
COAL MINES

REGION		STATE	BPT NUMBER OPERATING	BAT-2 NUMBER OPERATING	BAT-2 GAIN (LOSS)	BAT-4 NUMBER OPERATING	BAT-4 GAIN (LOSS)
Northern Appalachia	1	PA	189	189	0	183	(6)
	2	OH	103	103	0	104	1
	3	MD	19	19	0	19	0
	4	WV(N)	51	51	0	51	0
			362	362	0	357	(5)
Central Appalachia	5	WV(S)	117	117	0	120	3
	6	VA	90	90	0	90	0
	7	KY(E)	141	141	0	141	0
	8	TN	27	27	0	27	0
			375	375	0	378	3
Southern Appalachia	9	AL	88	89	1	89	1
Midwest	10	IL	40	40	0	40	0
	11	IN	40	40	0	40	0
	12	KY(W)	52	52	0	52	0
	13	LA	4	4	0	4	0
			136	136	0	136	0
Central West	14	MO	6	6	0	6	0
	15	KS	3	3	0	3	0
	16	AR	3	3	0	3	0
	17	OK	22	22	0	22	0
			34	34	0	34	0
Gulf	18	TX	5	5	0	5	0
Great Plains	19	ND	20	20	0	20	0
	20	SD	-	-	-	-	-
	21	WY(P)	26	26	0	26	0
	22	MT	15	15	0	15	0
			67	61	0	61	0
Rockies	23	WY(O)	93	93	0	94	1
	24	CO(N)	-	-	-	-	-
	25	CO(S)	13	13	0	13	0
	26	UT	1	0	(1)	0	(1)
			107	106	(1)	107	0
Southwest	27	AZ	3	3	0	3	0
	28	NM	3	3	0	3	0
			6	6	0	6	0
Northwest	29	WA	2	2	0	2	0
TOTAL			1176	1176	0	1175	(1)

TABLE-10

1984 PRIMARY IMPACT SUMMARY

NUMBER OF SPOT MARKET

COAL MINES

Area	Region		BPT NUMBER OPERATING	BAT-2 NUMBER OPERATING	BAT-2 GAIN (LOSS)	BPT-4 NUMBER OPERATING	BPT-4 GAIN (LOSS)
Northern Appalachia	1	PA	401	400	(1)	373	(28)
	2	OH	89	89	0	69	(20)
	3	MD	14	14	0	15	1
	4	WV(N)	89	89	0	87	(2)
			593	592	(1)	544	(49)
Central Appalachia	5	WV(S)	339	338	(1)	338	(1)
	6	VA	246	246	0	246	0
	7	KY(E)	366	366	0	393	27
	8	TN	90	90	0	90	0
			1041	1040	(1)	1067	26
Southern Appalachia	9	AL	9	9	0	9	0
Midwest	10	IL	31	31	0	31	0
	11	IN	8	8	0	8	0
	12	KY(W)	21	21	0	21	0
	13	LA	-	-	-	-	-
			60	60	0	60	0
Central West	14	MO	-	-	-	-	-
	15	KS	-	-	-	-	-
	16	AR	-	-	-	-	-
	17	OK	19	19	0	19	0
			19	19	0	19	0
Gulf	18	TX	-	-	-	-	-
Great Plains	19	ND	-	-	-	-	-
	20	SD	-	-	-	-	-
	21	WY(P)	-	-	-	-	-
	22	MT	-	-	-	-	-
Rockies	23	WY(O)	-	-	-	-	-
	24	CO(N)	-	-	-	-	-
	25	CO(S)	6	6	0	6	0
	26	UT	-	-	-	-	-
			6	6	0	6	0
Southwest	27	AZ	-	-	-	-	-
	28	NM	-	-	-	-	-
Northwest	29	WA	-	-	-	-	-
TOTAL US			1728	1726	(2)	1705	(23)

TABLE V-11

1984 PRIMARY IMPACT SUMMARY
CHANGES IN NUMBER OF MINES FROM BPT
SPOT AND CONTRACT MARKET COAL MINES

Area	Region		BPT-2 GAIN (LOSS) (NUMBER)	BPT-2 GAIN (LOSS) (%)	BPT-4 GAIN (LOSS) (NUMBER)	BPT-4 GAIN (LOSS) (%)
Northern Appalachia	1	PA	(1)	(0.2)	(34)	(5.8)
	2	OH	0	0	(19)	(9.9)
	3	MD	0	0	1	3.0
	4	WV(N)	0	0	(2)	(1.4)
			(1)	(0.1)	(54)	(517)
Central Appalachia	5	WV(S)	(1)	(0.2)	(1)	(0.2)
	6	VA	0	0	0	0
	7	KY(E)	0	0	27	5.3
	8	TN	0	0	0	0
			(1)	(0.1)	26	1.8
Southern Appalachia	9	AL	1	0	1	0
Midwest	10	IL	0	0	0	0
	11	IN	0	0	0	0
	12	KY(W)	0	0	0	0
	13	LA	0	0	0	0
Central West	14	MO	0	0	0	0
	15	KS	0	0	0	0
	16	AR	0	0	0	0
	17	OK	0	0	0	0
Gulf	18	TX	0	0	0	0
Great Plains	19	ND	0	0	0	0
	20	SD	-	-	-	-
	21	WY(P)	0	0	0	0
	22	MT	0	0	0	0
Rockies	23	WY(O)	0	0	0	0
	24	CO(N)	-	-	-	-
	25	CO(S)	0	0	0	0
	26	UT	(1)	(100.0)	(1)	(100.0)
Southwest	27	AZ	0	0	0	0
	28	NM	0	0	0	0
Northwest	29	WA	0	0	0	0
			(2)	(0.1)	(28)	(1.0)

tration of acidic water flows in those regions where smaller mines are prevalent.

The reduction in the number of operating mines is moderate and the overall competitive structure of the coal mining industry should not be significantly reduced. Those areas with large numbers of mines, particularly spot market mines, continue to have substantial numbers of mines, and the mines of any particular region are in competition with mines in other regions. The expansion of coal production in the Northern Great Plains would serve to increase the competition among sellers in those regions, but those regions would continue to be dominated by very large mines providing coal for customers on a long-term contract basis.

C. Employment Effects

In this section, we shall discuss the direct effects of the BAT control options on employment and wages, as well as the indirect (secondary) regional effects.

1. Direct Regional Effects

The impact of the BAT control options on employment are approximately parallel to the impact on production. Tables V-12 and -13 show the levels of employment under the BPT and BAT control option cases along with the employment changes from BPT for contract and spot market mines. The overall impact on contract market mines is to reduce the levels of employment because coal production lost in Northern Appalachia is replaced by increased Northern Great Plains coal. Those Western regions are dominated by strip mine production with higher labor productivities. The impact on spot market mines is limited to smaller mines, which exhibit smaller interregional labor productivity differences. The overall employment impact on spot mines is very small.

No significant impact is expected on employment under BAT-2. The negative employment impact under BAT-4 is completely concentrated in Northern Appalachia. These impacts are consistent with the impact of the control options on production.

The total direct employment impact for contract and spot market mines combined is shown in Table V-14. Here the most significant measure is the percentage shift of employment from the BPT case. BAT-2 is not expected to result in any significant employment shift. The BAT-4 control option is expected to result in a few declines of coal mining employment in some regions. Pennsylvania is expected to have the largest proportional decline, just over 7 percent, and the declines are concentrated in Northern Appalachia. Employment gains are expected in Wyoming and Central Appalachia Regions where production is increased. Nationally, there is a small net loss of employment since the main production increase (Wyoming Powder River) is in mines with very high labor productivities.

TABLE V-12

1984 PRIMARY IMPACT SUMMARY

EMPLOYMENT LEVELS

CONTRACT MARKET COAL MINES

Area	Region		BPT EMPLOYEES	BAT-2 EMPLOYEES	BAT-2 GAIN (LOSS)	BAT-4 EMPLOYEES	BAT-4 GAIN (LOSS)
Northern Appalachia	1	PA	17400	17400	0	16130	(1270)
	2	OH	10140	10140	0	10300	160
	3	MD	1530	1530	0	1530	0
	4	WV(N)	6190	6190	0	6190	0
			35250	35260	0	35150	1110
Central Appalachia	5	WV(S)	10020	10020	0	10180	160
	6	VA	4880	4880	0	4960	80
	7	KY(E)	10930	10930	0	10930	0
	8	TN	1680	1680	0	1680	0
			27510	27510	0	27750	240
Southern Appalachia	9	AL	8400	8400	0	8470	70
Midwest	10	IL	7590	7590	0	7590	0
	11	IN	5580	5580	0	5580	0
	12	KY(W)	8510	8510	0	8510	0
	13	LA	50	50	0	50	0
			21730	21730		21730	0
Central West	14	MO	770	770	0	770	0
	15	KS	40	40	0	40	0
	16	AR	50	50	0	50	0
	17	OK	600	600	0	600	0
			1460	1460		1460	0
Gulf	18	TX	2980	2980	0	2980	0
Great Plains	19	ND	1750	1750	0	1750	0
	20	SD	-	-	-	-	-
	21	WY(P)	24190	24190	0	24550	360
	22	MT	6150	6150	0	6150	0
			32090	32090		32450	360
Rockies	23	WY(O)	5170	5170	0	5170	0
	24	CO(N)	-	-	-	-	-
	25	CO(S)	3130	3130	0	3130	0
	26	UT	80	0	(80)	0	(80)
			8380	8300	(80)	8300	(80)
Southwest	27	AZ	2250	2250	0	2250	0
	28	NM	1370	1370	0	1370	0
			3620	3620	0	3620	0
Northwest	29	WA	1850	1850	0	1850	0
TOTAL US			143280	143200	(80)	142610	(590)

TABLE V-13

1984 PRIMARY IMPACT SUMMARY

EMPLOYMENT LEVELS

SPOT MARKET COAL MINES

Area	Region		BPT EMPLOYEES	BAT-2 EMPLOYEES	BAT-2 GAIN (LOSS)	BAT-4 EMPLOYEES	BAT-4 GAIN (LOSS)
Northern Appalachia	1	PA	3410	3390	(20)	3150	(260)
	2	OH	930	930	0	690	(240)
	3	MD	80	80	0	90	10
	4	WV(N)	80	80	0	80	0
			4500	4480	(20)	4010	(490)
Central Appalachia	5	WV(S)	2730	2730	0	2730	0
	6	VA	1740	1740	0	1740	0
	7	KY(E)	2950	2950	0	3150	200
	8	TN	620	620	0	620	0
			8040	8040		8240	200
Southern Appalachia	9	AL	10	10	0	10	0
Midwest	10	IL	18560	18560	0	18560	0
	11	IN	50	50	0	50	0
	12	KY(W)	430	430	0	430	0
	13	LA	-	-	-	-	-
			19040	19040	0	19040	0
Central West	14	MO	-	-	-	-	-
	15	KS	-	-	-	-	-
	16	AR	-	-	-	-	-
	17	OK	160	160	0	160	0
Gulf	18	TX	-	-	-	-	-
Great Plains	19	ND	-	-	-	-	-
	20	SD	-	-	-	-	-
	21	WY(P)	*	*	0	*	0
	22	MT	-	-	-	-	-
Rockies	23	WY(O)	-	-	-	-	-
	24	CO(N)	-	-	-	-	-
	25	CO(S)	110	110	0	110	0
	26	UT	-	-	-	-	-
Southwest	27	AZ	-	-	-	-	-
	28	NM	-	-	-	-	-
Northwest	29	WA	-	-	-	-	-
TOTAL US			31860	31840	(20)	31570	(290)

TABLE V-14

1984 PRIMARY IMPACT SUMMARY
CHANGES IN EMPLOYMENT FROM BPT
SPOT AND CONTRACT MARKET COAL MINES

Area	Region		BAT-2 GAIN (LOSS) EMPLOYEES	BAT-2 GAIN (LOSS) %	BAT-4 GAIN (LOSS) EMPLOYEES	BAT-4 GAIN (LOSS) %
Northern Appalachia	1	PA	0	0	(1530)	(7.4)
	2	OH	0	0	(90)	(0.8)
	3	MD	0	0	10	0.6
	4	WV(N)	0	0	0	0
					(1610)	(4.1)
Central Appalachia	5	WV(S)	0	0	160	1.3
	6	VA	0	0	80	1.2
	7	KY(E)	0	0	200	1.4
	8	TN	0	0	0	0
					440	1.2
Southern Appalachia	9	AL	0	0	0	0
Midwest	10	IL	0	0	0	0
	11	IN	0	0	0	0
	12	KY(W)	0	0	0	0
	13	LA	0	0	0	0
Central West	14	MO	0	0	0	0
	15	KS	0	0	0	0
	16	AR	0	0	0	0
	17	OK	0	0	0	0
Gulf	18	TX	0	0	0	0
Great Plains	19	ND	0	0	0	0
	20	SD	-	-	-	-
	21	WY(P)	0	0	360	1.5
	22	MT	0	0	0	0
					360	1.1
Rockies	23	WY(O)	0	0	0	0
	24	CO(N)	-	-	-	-
	25	CO(S)	0	0	0	0
	26	UT	(80)	(100.0)	(80)	(100.0)
			(80)	(1.0)	(80)	(1.0)
Southwest	27	AZ	0	0	0	0
	28	NM	0	0	0	0
Northwest	29	WA	0	0	0	0
			(80)	*	(890)	(0.5)

* Less than 0.05%

Wage shifts are of virtually identical pattern to employment shifts. The only variation is due to the relative magnitude of loss or gains from contract and spot market mines in each region because the spot market mines on the whole have lower wage rates. The expected wage shifts are summarized in a single table combining contract and spot market mines (see Table V-15).

2. Indirect Regional Effects

The direct shifts of employment and wages in coal mining due to compliance with the regulations are moderate and confined to some regions. The overall regional impact of those shifts will depend on the role played by coal mining in that economy. If coal mining is a small component of the region's economy, then even dramatic shifts in coal mining will result in a minor overall impact. A first step in assessing the community impact of the coal mining regulations is thus to quantify the role of coal mining in regional economic structures.

Table V-16 presents an estimate of the percentage of total earnings accounted for by coal mining for selected states in 1984. The states in this table have been arranged into three groups -- east to west -- and north to south within each group. The table shows West Virginia to be the most coal-mining-dependent state; here coal mining accounts for over 15% of total earnings. Wyoming and Kentucky are the only other states where coal mining is expected to account for more than 2% of total earnings.

Table V-16 also shows the expected shifts in earnings as a percent of total coal mining earnings and as a percent of the total earnings for the state, under BAT-4. Pennsylvania would face reduced direct total earnings of about 0.1%, while Ohio, West Virginia and Virginia would be expected to gain about 0.1% in total statewide earnings.

The impact on the state or community is not limited to the jobs and wages gained or lost from coal mining alone. A portion of the wages earned by coal miners is spent on local goods and services. When coal mining wages are lost, then these purchases of local goods and services are also reduced, multiplying the impact from the loss of coal mining wages. The magnitude of the loss multiplication depends on the proportion of local wages and salaries that is spent on locally-produced goods and services. To the extent a region's goods and services are purchased outside the region, the impact of reduced wages is shifted outside the region.

A measure of how much of a region's income will be spent outside the region is the extent to which the region produces for "export", in order to be able to "import". This depends on the extent to which the area specializes in specific industries. As a region becomes more specialized, it will trade with other regions, selling the goods and services it specializes in and importing the desired goods and serivces it demands but does not produce. The Regional Division of the Bureau of Economic Analysis of the Department

TABLE V-15

1984 PRIMARY IMPACT SUMMARY

CHANGES IN WAGES FROM BPT

SPOT AND CONTRACT MARKET COAL MINES

Area	Region		BAT-2 GAIN (LOSS) ($MM/YR)	BAT-2 GAIN (LOSS) (%)	BAT-4 GAIN (LOSS) ($MM/YR)	BAT-4 GAIN (LOSS) (%)
Northern Appalachia	1	PA	0	(0)	(24.36)	(7.3)
	2	OH	0	0	2.70	1.4
	3	MD	0	0	0	0
	4	WV(N)	0	0	0	0
					(21.66)	(3.0)
Central Appalachia	5	WV(S)	0	0	3.03	1.6
	6	VA	0	0	1.58	1.7
	7	KY(E)	0	0	0.19	0.1
	8	TN	0	0	0	0
					4.80	0.8
Southern Appalachia	9	AL	0	0	1.34	0.8
Midwest	10	IL	0	0	0	0
	11	IN	0	0	0	0
	12	KY(W)	0	0	0	0
	13	LA	0	0	0	0
Central West	14	MO	0	0	0	0
	15	KS	0	0	0	0
	16	AR	0	0	0	0
	17	OK	0	0	0	0
Gulf	18	TX	0	0	0	0
Great Plains	19	ND	0	0	0	0
	20	SD	-	-	-	-
	21	WY(P)	0	0	6.81	1.5
	22	MT	0	0	0	0
					6.81	
Rockies	23	WY(O)	0	0	0	0
	24	CO(N)	-	-	-	-
	25	CO(S)	0	0	0	0
	26	UT	*	*	*	*
Southwest	27	AZ	0	0	0	0
	28	NM	0	0	0	0
Northwest	29	WA	0	0	0	0
TOTAL US			0	0	(8.71)	(0.3)

* Less than 0.05

TABLE V-16

IMPORTANCE OF COAL MINING FOR SELECTED STATES

State	Coal Mining's Expected Share of Total Earnings in 1984[1] (%)	Economic Impact[2] BAT-2 Shift in Coal Mining Earnings (%)	BAT-2 Direct Shift in Total State Earnings (%)	BAT-4 Shift in Coal Mining Earnings (%)	BAT-4 Direct Shift in Total State Earnings (%)
Pennsylvania	1.54	0	0	-7.3	-0.11
Ohio	0.62	0	0	1.4	0.109
Maryland	0.09	0	0	0	0
West Virginia	15.53	0	0	0.9	0.14
Virginia	1.65	0	0	1.7	0.03
Kentucky	5:77	0	0	*	*
Tennessee	0.43	0	0	0	0
Alabama	1.28	0	0	0	0
Illinois	0.44	0	0	0	0
Indiana	0.31	0	0	0	0
Iowa	0.04	0	0	0	0
Missouri	0.16	0	0	0	0
Kansas	0.08	0	0	0	0
Arkansas	0.08	0	0	0	0
Oklahoma	0.12	0	0	0	0
Texas	0.01	0	0	0	0
North Dakota	0.42	0	0	1.5	0.12
Wyoming	8.12	0	0	0	0
Montana	1.54	0	0	0	0
Colorado	0.37	0	0	0	0
Utah	1.09	0	0	0	0
New Mexico	0.78	0	0	0	0
Washington	0.06	0	0	0	0

[1] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Division; Population, Personal Income, and Earnings by State: Projections to 2000 for Office of Water Program Operations, EPA, October 1977.

[2] Arthur D. Little, Inc. estimates.

* Less than ±.01%.

of Commerce has constructed an index, the specialization ratio*, indicating the extent to which state economies are specialized in specific activities. The higher the value of this specialization ratio, the greater the propensity of the state to import and export. The specialization ratios for the selected coal mining states are shown in Table V-17. The specialization ratio provides an estimate of the proportion of earnings derived from export activities, and this, together with the marginal propensity to consume, gives the multiplier ** which should be applied to the direct loss (or gain) of earnings from coal mining to estimate the total earnings loss (or gain) in the state. These multipliers are also presented in Table V-17 along with the estimated total earnings loss (or gain) as a percent of total state earnings under BAT-2 and BAT-4 control options. These estimates must be considered rather coarse. The estimates rest on certain major assumptions of consumption and savings patterns of states. For instance, a marginal propensity of consumption of 0.9 is assumed for all states, but the detailed information about individual states' comsumption and savings patterns required to adjust these assumptions is not readily available.

The earnings shifts expected under option BAT-2 show the concentration of negative impacts in Pennsylvania, Kentucky, West Virginia, and Virginia. Under option BAT-4 the adverse impact is shifted most heavily to Pennsylvania, less to Kentucky and Ohio, with some gains in earnings resulting in Virginia and West Virginia.

The BAT-4 control option would shift coal production to and expand earnings in the Northern Plains and Central Appalachia. These shifts in state earnings can be put into some perspective by comparing the expected earnings shift with the expected rate of growth for the state. It is also instructive to note whether the impacted states have income levels above or below the national average. The negative impacts of water effluent regulations would be more serious if they fall on areas which are expected to be slow-growing and/or are already relatively depressed. Table V-18 shows the annual rate of earnings growth from 1976 to 1984 and the level of per capita personal income, relative to the national average, for the selected coal-producing states.

The total earnings shifts expected from the control options are less than an expected year's growth for all states. The largest negative impact falls in Pennsylvania, a state expected to be at just about the national average in per capita personal imcome. Under BAT-4, West Virginia, Virginia, and Kentucky would gain earnings, and these are at or below the national average per capita income.

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*The specialization ratio is defined as the sum across all industries in a region of the difference between the ratio of each industry's share of total earnings and that ratio for the nation, where that difference is positive.

**Regional multiplier = $1/[1 - .9 \times (1 - \text{Specialization Ratio})]$

TABLE V-17

ESTIMATED TOTAL IMPACT FROM
EFFLUENT CONTROL GUIDELINES

State	Specialization Ratio[1]	Estimated Multiplier[2]	Direct and Indirect Earnings Shift[3] (Percent) BAT-2	BAT-4
Pennsylvania	.122	4.8	0	-0.5
Ohio	.152	4.2	0	0.3
Maryland	.150	4.3	0	0
West Virginia	.261	3.0	0	0.4
Virginia	.142	4.4	0	*
Kentucky	.146	4.3	0	0
Tennessee	.122	4.8	0	0
Alabama	.144	4.4	0	0
Illinois	.093	5.4	0	0
Indiana	.178	3.8	0	0
Iowa	.207	3.5	0	0
Missouri	.090	5.5	0	0
Kansas	.152	4.2	0	0
Arkansas	.174	3.9	0	0
Oklahoma	.127	4.7	0	0
Texas	.105	5.1	0	0
North Dakota	.272	2.9	0	0
Wyoming	.333	2.5	0	0.3
Montana	.234	3.2	0	0
Colorado	.104	5.2	0	0
Utah	.143	4.4	0	0
New Mexico	.226	3.3	0	0
Washington	.156	4.2	0	0

[1] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Division; Population, Personal Income, and Earnings by State: Projections to 2000 for Office of Water Program Operations, EPA, October 1977.

[2] Arthur D. Little, Inc. estimates.

* Less than ±0.1%.

TABLE V-18

IMPACT PERSPECTIVE

State	Annual Rate of Earnings Growth (Percent per annum)	Personal Per Capita Income Relative to Nation (Nation = 100.0)
Pennsylvania	3.5	101.
Ohio	4.2	101.
Maryland	4.3	109.
West Virginia	3.5	84.
Virginia	4.5	101.
Kentucky	4.8	88.
Tennessee	5.3	91.
Alabama	4.0	83.
Illinois	3.6	115.
Indiana	3.8	98.
Iowa	2.9	99.
Missouri	3.8	95.
Kansas	3.2	99.
Arkansas	4.6	83.
Oklahoma	3.7	89.
Texas	3.9	95.
North Dakota	1.9	84.
Wyoming	4.2	97.
Montana	2.8	88.
Colorado	4.2	100.
Utah	4.0	84.
New Mexico	2.8	78.
Washington	2.8	101.
Total U.S.	3.9	100.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Division; Population, Personal Income, and Earnings by State: Projections to 2000 for Office of Water Program Operations, EPA, October 1977.

D. Financial Effects

The BAT control options require additional investment in pollution control equipment. This investment must be funded from internally-generated cash and/or externally-raised funds. The required investment may significantly increase the cash required for total investment by the coal mining industry.

Cash flow has been estimated for individual model mines from after-tax earnings, depreciation, and depletion. Total investment has also been estimated from required replacement and expansion of mining operations plus the investment required for pollution control equipment. A measure of the sufficiency of cash flow to meet the total investment required is the proportion of that investment which could be funded from cash flow.

The investment requirements for pollution control equipment are very different under BAT-2 and BAT-4, with the latter requiring significantly greater investments. The time required to put the equipment in place for BAT-4 control means that the investment would be spread over two years. It has been assumed for this analysis that 60 percent of the control equipment investment would fall in one year of the construction program. Thus, the maximum annual cash required to fund the pollution control investment under BAT-4 would be 60 percent of the total investment expenditure. The investment requirements for BAT-2 are small and are assumed to take place in one year.

Tables V-19 and -20 show, for contract market mines, the expected cash flow generated, annual investment required in mining equipment and construction, the maximum annual investment required for pollution control equipment and the proportion of the total required annual investment which would be provided by the annual cash flow (Cash Flow Coverage) For contract market mines, investment expenditures required under the BPT base case could be funded from cash flow in most regions (see Table V-19). The cash generated from Northern and Central Appalachian mines would cover the total required investment from 1.6 to 1.8 times, i.e., cash flow is 60 to 80 percent greater than the cash required for investment. In only a few regions is cash generated insufficient to fund the required investment. In the Midwest, cash flow is generally sufficient to fund the required investment, but only with a 20 percent margin, but in Indiana internally generated cash would not cover the maximum required annual investment.

The capital requirements and the ability of cash flow to cover those requirements are the same under BPT and BAT-2. These are shown in Table V-19.

A comparison of Table V-19 and -20 shows minor reductions in the proportion of investment covered by cash flow under BAT-4. The investment required could still be covered by cash flow in most regions, but cash flow would be generally insufficient in the Central West. All regions would have to either increase

TABLE V-19

IMPACT SUMMARY, CONTRACT MARKET MINES

INVESTMENT REQUIREMENTS COMPARED WITH CASHFLOW

Control Level: BPT OR BAT-2

REGION		STATE	ANNUAL CASHFLOW ($MM)	ANNUAL INVESTMENT IN MINING EQUIP. ($MM)	MAXIMUM ANNUAL REQUIRED INVEST. IN CONTROL EQUIP. ($MM)	CASH FLOW COVERAGE
Northern Appalachia	1	PA	240.95	132.8	7.01	1.72
	2	OH	132.94	71.2	3.60	1.78
	3	MD	20.26	13.3	.46	1.47
	4	WV (N)	96.37	47.6	2.05	1.94
			490.52	264.9	13.12	1.76
Central Appalachia	5	WV (S)	151.84	75.6	4.79	1.89
	6	VA	78.68	49.4	3.52	1.49
	7	KY (E)	171.64	95.4	5.66	1.70
	8	TN	21.89	8.4	1.14	2.29
			424.05	228.8	15.11	1.74
Southern Appalachia	9	AL	106.81	52.6	3.14	1.92
Midwest	10	IL	124.93	104.0	1.31	1.19
	11	IN	101.85	106.1	1.16	.95
	12	KY (W)	153.32	108.9	1.70	1.33
	13	IA	1.45	2.0	0.08	.70
			381.55	321.0	4.25	1.17
Central West	14	MO	12.66	11.7	0.16	1.07
	15	KS	1.30	1.8	0.11	.68
	16	AR	1.63	2.3	0.08	.68
	17	OK	13.97	17.4	0.68	.77
			29.56	33.2	1.03	.86
Gulf	18	TX	39.95	21.3	0.18	1.86
Great Plains	19	ND	38.53	25.1	0.68	1.47
	20	SD	-	-	-	-
	21	WY(P)[1]	297.69	226.9	1.93	1.30
	22	MT	113.29	83.9	0.52	1.34
			449.51	335.9	3.13	1.33
Rockies	23	WY(O)[1]	82.29	60.3	0.45	1.35
	24	CO(N)	-	-	-	-
	25	CO(S)	48.39	38.8	0.52	1.23
	26	UT	0	0	0	
			130.68	99.1	.97	1.31
Southwest	27	AZ	28.55	13.5	0.09	2.10
	28	NM	15.84	4.6	0.10	3.37
			44.39	18.1	.19	2.43
Northwest	29	WA	25.59	16.3	0.08	1.56
			2122.59	1391.2	41.20	1.48

[1] WY(P) is Wyoming, Powder River Basin; WY(O) is Wyoming, Other Areas.

TABLE V-20

IMPACT SUMMARY, CONTRACT MARKET MINES

INVESTMENT REQUIREMENTS COMPARED WITH CASHFLOW

Control Level: BAT-4

REGION		STATE	ANNUAL CASHFLOW ($MM)	ANNUAL INVESTMENT IN MINING EQUIP. ($MM)	MAXIMUM ANNUAL REQUIRED INVEST. IN CONTROL EQUIP. ($MM)	CASH FLOW COVERAGE
Northern Appalachia	1	PA	228.80	122.90	26.84	1.53
	2	OH	140.57	72.00	13.50	1.64
	3	MD	20.26	13.30	1.87	1.34
	4	WV(N)	96.37	47.60	6.95	1.77
			486.00	255.80	49.16	1.59
Central Appalachia	5	WV(S)	155.99	76.30	18.16	1.65
	6	VA	81.88	50.50	13.09	1.29
	7	KY(E)	171.64	95.40	22.31	1.46
	8	TN	22.38	11.30	3.82	1.48
			431.89	233.50	57.38	1.48
Southern Appalachia	9	AL	110.53	66.40	13.81	1.38
Midwest	10	IL	126.84	104.00	5.34	1.16
	11	IN	103.96	106.10	4.31	.94
	12	KY(W)	155.03	108.90	6.14	1.35
	13	IA	1.46	2.00	0.17	0.67
			387.29	321.00	15.96	1.15
Central West	14	MO	12.87	11.70	0.41	1.06
	15	KS	1.32	1.80	0.35	0.61
	16	AR	1.65	2.30	0.21	0.66
	17	OK	14.17	17.40	2.99	0.70
			30.01	33.20	3.96	0.81
Gulf	18	TX	40.19	21.30	0.58	1.84
Great Plains	19	ND	38.53	25.10	0.68	1.49
	20	SD	-	-	-	-
	21	WY(P)[1]	301.72	229.97	1.95	1.30
	22	MT	112.53	83.30	0.52	1.34
			452.78	313.27	3.15	1.43
Rockies	23	WY(O)[1]	82.29	60.30	0.45	1.35
	24	CO(N)	-	-	-	-
	25	CO(S)	48.39	38.80	0.52	1.23
	26	UT	0	0	0	0
			130.68	99.10	.97	1.31
Southwest	27	AZ	28.55	13.50	0.09	2.10
	28	NM	15.84	4.60	0.10	3.37
			44.39	18.10	.19	2.43
Northwest	29	WA	25.59	16.30	0.08	1.56
			2139.35	1377.97	145.24	1.40

[1] WY(P) is Wyoming, Powder River Basin; WY(O) is Wyoming, Other Areas.

borrowing or reduce payments to owners in the year requiring the maximum pollution control investment. The investment requirements of the BAT-4 control option are estimated to result in a minor financial impact on the contract coal mining industry.

Tables V-21 and -22 show, in the same way, the financial impact of the three control cases on spot market mines. Cash flow coverage of investment requirements for spot market mines is less generous than for contract market mines; cash flow exceeds investment requirements by only 5 percent to 20 percent in most regions. The investment requirements of BAT-2 result in no significant shift of cash flow coverage of investment requirements. Spot market mines would not be required to either increase borrowing or reduce payments to owners in order to fund the small investment requirements of BAT-2.

Spot market mines are heavily impacted in financial terms under BAT-4. Table V-22 shows that in every region but one, cash flow would be insufficient to cover the maximum annual investment required. This means that these mines would be forced to raise substantial additional external funds either through borrowing or additional owner equity to meet the BAT-4 standards. These mines might well face difficulty in raising substantial additional funds because of the limited sources of financing for many small mines.

The study has not made a detailed analysis of the sources of funds available to small mines and thus cannot determine the extent that capital constraints might lead to additional closures of spot market mines. However, the magnitude of the financial effects of BAT-4 on these small mines makes additional closures a distinct possibility due to financing constraints.

E. Industry Growth

The potential impact of the BAT control options on future industry growth could result from two factors: a reduction in the growth of demand for coal and/or a reduction in the potential growth of coal supplies.

The increase in coal prices resulting from either control option has been determined not to alter the demand for coal in the years when the regulations come into effect. The major increases in coal utilization are expected to be in the Western states where the control options would result in relatively low coal price increases. Even including the cost increases due to the regulations, coal remains the least expensive source of energy for large energy installations in those areas which account for the major share of total coal demand growth. Many factors may limit long-term growth in coal demand, but the costs resulting from the BAT control options are not among them.

TABLE V-21

PRIMARY IMPACT SUMMARY - SPOT MARKET MINES INVESTMENT REQUIREMENTS COMPARED WITH CASH FLOW

CONTROL LEVEL: BPT OR BAT-2

Area	Region		Cash Flow ($MM)	Annual Required Investment In Mining Equipment[2] ($MM)	Maximum Annual Required Investment In Control Equipment ($MM)	Cash Flow Coverage
Northern Appalachia	1	PA	46.32	25.75	11.35	1.25
	2	OH	10.48	5.99	2.08	1.30
	3	MD	2.27	1.45	0.45	1.20
	4	WV(N)	11.55	6.08	2.62	1.33
			70.62	39.27	16.50	1.27
Central Appalachia	5	WV(S)	35.85	11.37	12.56	1.50
	6	VA	26.74	10.18	8.23	1.45
	7	KY(E)	37.12	17.91	11.24	1.27
	8	TN	8.58	3.61	2.70	1.36
			108.29	43.07	34.73	1.39
Southern Appalachia	9	AL	1.08	0.81	0.31	0.96
Midwest	10	IL	348.14	214.67	1.23	1.61
	11	IN	1.47	0.85	0.24	1.35
	12	KY(W)	3.96	2.82	0.52	1.18
	13	LA	-	-	-	-
			353.57	218.34	1.99	1.60
Central West	14	MO	-	-	-	-
	15	KS	-	-	-	-
	16	AR	-	-	-	-
	17	OK	1.53	0.71	0.49	1.28
Gulf	18	TX	-	-	-	-
Great Plains	19	ND	-	-	-	-
	20	SD	-	-	-	-
	21	WY(P)	*	*	*	*
	22	MT	-	-	-	-
Rockies	23	WY(O)	-	-	-	-
	24	CO(N)	-	-	-	-
	25	CO(S)	1.23	0.66	0.08	1.66
	26	UT	-	-	-	-
Southwest	27	AZ	-	-	-	-
	28	NM	-	-	-	-
Northwest	29	WA	-	-	-	-
TOTAL US			536.32	302.86	54.10	1.50

[1] WY(O) is Wyoming, other areas, WY(P) is Wyoming, Powder River Basin.

[2] For the estimated remaining life of all mines (5 year average).

* Spot market coal supplied by surplus contract mine production.

TABLE V-22

PRIMARY IMPACT SUMMARY - SPOT MARKET MINES INVESTMENT REQUIREMENTS COMPARED WITH CASH FLOW

CONTROL LEVEL: BAT-4

Area	Region		Annual Cash Flow ($ MM)	Annual Required Investment In Mining Equipment[2] ($ MM)	Maximum Annual Required Investment In Control Equipment ($ MM)	Cash Flow Coverage
Northern Appalachia	1	PA	46.69	24.99	30.57	0.84
	2	OH	9.36	5.14	4.68	0.95
	3	MD	2.81	1.56	1.33	0.97
	4	WV(N)	12.74	6.08	7.96	0.91
			71.60	37.77	44.54	0.87
Central Appalachia	5	WV(S)	37.52	11.37	37.07	0.77
	6	VA	28.70	10.18	22.83	0.87
	7	KY(E)	42.78	18.46	35.26	0.80
	8	TN	9.69	3.61	7.07	0.95
			118.69	43.62	102.23	0.81
Southern Appalachia	9	AL	1.17	0.81	0.88	0.69
Midwest	10	IL	348.14	214.67	4.31	1.59
	11	IN	1.47	0.85	0.68	0.96
	12	KY(W)	3.96	2.83	2.18	0.79
	13	LA	-	-	-	-
			353.57	218.35	7.17	1.57
Central West	14	MO	-	-	-	-
	15	KS	-	-	-	-
	16	AR	-	-	-	-
	17	OK	1.76	0.71	1.36	0.85
Gulf	18	TX	-	-	-	-
Great Plains	19	ND	-	-	-	-
	20	SD	-	-	-	-
	21	WY(P)[1]	*	*	*	*
	22	MT	-	-	-	-
Rockies	23	WY(O)[1]	-	-	-	-
	24	CO(N)	-	-	-	-
	25	CO(S)	1.23	0.66	0.08	1.66
	26	UT	-	-	-	-
Southwest	27	AZ	-	-	-	-
	28	NM	-	-	-	-
Northwest	29	WA	-	-	-	-
TOTAL US			548.02	301.92	155.38	1.20

[1] WY(P) is Wyoming, Powder River Basin; WY(O) is Wyoming, other areas.

[2] For the estimated remaining life of all mines (approximately 5 years average).

[3] Spot market coal supplied by surplus contract mine production.

The BAT control options have been shown to result in minor declines in production in Northern Appalachia. These production declines result from shifts in the relative costs of production between regions. Those areas where production is expected to be lost in 1984 can be expected to experience slower rates of production growth in the future.

In like manner, those areas gaining production under the control options in 1984 would be expected to see an acceleration in their rates of growth. To demonstrate the adequacy of coal reserves in those areas which would be expected to grow more rapidly, Table V-23 shows the reserves of coal available by state as tabulated by the Bureau of Mines in 1975. The regions in the Northern Great Plains expected to experience higher rates of growth are areas which have a major share of total national reserves. The largest regional production increase under the control options is expeced in Wyoming where reserves would be expected to last over 200 years at the 1984 production rate under BAT-4.

The United States has vast coal reserves and though the control options alter the reserves expected to be used, those reserves provide no constraint on supplies over the next several generations.

F. Balance of Payments Effects

Exports are an important component of demand for coal, but the coal exported is predominantly metallurgical coal. The demand for metallurgical coal is price-inelastic and demand is not expected to be significantly changed by the anticipated mining cost increases resulting from the regulations. Alterations are expected in worldwide trading patterns of coal but these will be the result of investment in new coal resources such as in Australia. These developments are not expected to be accelerated by the relatively small increases (6-8%) expected in metallurgical coal costs due to the regulations.

The United States does export both energy coal and metallurgical coal to Canada. The eastern coal fields of the United States constitute the closest coal resource to eastern Canada and the cost changes expected from compliance with the regulations (1-2%) would not make any other coal or energy resource economically viable.

Since the guidelines are not expected to result in any significant alteration of U.S. coal export volumes, the small price increases expected would simply increase coal export earnings slightly (6-8%).

The amount of coal imported to the United States is very small and represents a small number of special circumstances. The price increases resulting from the guidelines are not expected to affect these imports.

TABLE V-23

COAL RESERVE BASE BY STATE

Area	Region		Total Coal Reserve Base (MMTONS)	Percent of Total Reserves
Northern Appalachia	1	PA	23,800	5.7
	2	OH	21,077	5.0
	3	MD	1,048	0.3
	4	WV(N)	39,590	9.5
Central Appalachia	5	WV(S)		
	6	VA	3,650	0.9
	7	KY(E)	12,917	3.1
	8	TN	987	0.2
Southern Appalachia	9	AL	2,982	0.7
Midwest	10	IL	65,665	15.7
	11	IN	10,623	2.5
	12	KY(W)	12,624	3.0
	13	LA	2,885	0.7
Central West	14	MO	9,487	2.3
	15	KS	1,388	0.3
	16	AR	569	0.1
	17	OK	1,294	0.3
Gulf	18	TX	4,042	1.0
Great Plains	19	ND	16,003	3.8
	20	SD	-	-
	21	WY(P)	53,336	12.8
	22	MT	108,396	25.8
Rockies	23	WY(O)	N/A	-
	24	CO(N)	14,850	3.6
	25	CO(S)		
	26	UT	4,042	1.0
Southwest	27	AZ	350	0.1
	28	NM	4,393	1.1
Northwest	29	WA	1.954	0.5
TOTAL			418,034	100.0

N/A - Wyoming Other, not available only whole state.

Source: U.S. Department of Interior Bureau of Mines, The Reserve Base of U.S. Coals by Sulfur Content: 1, The Eastern States. Information Circular 8680 2, The Western States Information Circular 8693. Washington, D.C. 1975.

The effluent regulations studied are not expected to alter prices sufficiently to make the replacement of coal by oil an economic alternative. Coal remains the significantly cheaper alternative in the uses expected of it. Since the regulations are not expected to result in increased oil use, they would have no impact on the balance of payments through increased oil imports.

The net effect of the regulations is expected to be a slight (negligible) increase in the value of U.S. exports.

G. Community Effects

The secondary impacts of the effluent limitations have been described and quantified above for states. The closure of a mine will concentrate the economic impact in the specific community where that mine is located. The importance of coal mining in smaller areas can be seen from the percentage of total employment accounted for by coal mining in selected counties which account for a substantial share of selected states' totals (see Table V-24). There is considerable variation in the importance of coal mining within counties. Coal is a minor activity in some areas where the resource is located within major metropolitan areas such as Allegheny County (Pittsburgh) Pennsylvania, but coal mining accounts for 50 percent or more of total employment in several counties, where the effects of mine closings could be more substantial.

The mine-by-mine analysis needed for a community-scale analysis was rendered impossible by the lack of water-flow data except for a small sample of mines. We could overcome this lack on a regional level by using the statistical approach outlined in Section IV, but it is not possible to do so where only a few mines are concerned.

The estimates of impacts made by this study cannot differentiate between counties, but it must be recognized that the community impacts of mine closures would be much larger than for a state as a whole.

The direct impact of a mine closure would be accentuated in those counties where coal mining constitutes the major economic activity. However, the greater the concentration of total county economic activity in coal mining, the smaller the secondary impact multiplier will be. The concentration in coal means that the county is highly specialized and must import a large share of consumption goods and services. This high proportion of imports reduces the secondary impact in the county where jobs and earnings are lost. The secondary impacts are in effect "exported" to the areas from which the community purchased goods and services.

TABLE V-24

COAL MINING'S SHARE OF TOTAL EMPLOYMENT
FOR SELECTED COUNTIES
1976

Pennsylvania		Maryland		West Virginia		Virginia	
County	Share	County	Share	County	Share	County	Share
Allegheny	0.4%	Allegany	1.2%	Boone	73.5%	Buchanan	67.0%
Armstrong	12.0	Garrett	8.0	Harrison	7.7	Dickenson	59.3
Cambria	7.7			Kanawha	7.7	Lee	38.3
Clearfield	9.2			Logan	47.1	Wise	24.6
Greene	50.3			McDowell	26.2		
Indiana	24.0			Monongalia	21.8		
				Raleigh	28.9		
				Wyoming	71.6		

Ohio		Kentucky		Alabama	
County	Share	County	Share	County	Share
Belmont	23.6%	Harlan	48.5%	Jefferson	1.9%
Harison	50.0	Letcher	46.8	Walker	24.2
Jefferson	6.5	Muhlenberg	44.5		
Perry	19.7	Hopkins	17.2		
		Union	54.0		
		Bell	15.4		
		Clay	37.1		
		Martin	65.7		
		Pike	49.4		

Source: Derived from U.S. Department of Commerce, Bureau of Census, County Business Patterns, 1976.

The current analysis cannot quantitatively assess these impacts because it is unable to deal with individual specific mines. However, it is appropriate to recognize that the adverse impacts of the regulations are concentrated in the specific areas where closures occur and that the quantitative assessment of the adverse impacts must underestimate those impacts.

H. Impact on Energy Prices to Users

Coal production cost changes caused by compliance with the effluent control regulations translate into altered prices paid for coal by users. These altered prices are the result of three factors: 1) the altered costs of producing coal, 2) changes in transportation costs because coal may be supplied from more distant regions, and 3) changes in the costs of coal utilization because coals of "lower" quality may be used. These three factors have been taken into account by the analysis of the price and production effects on coal mining regions. The impacts of the changed costs on coal prices in the demand regions are now analyzed.

Analysis of the price shifts predicted by the impact model must be made with explicit recognition of the potential error of those price estimates inherent in the model. The linear program uses supply curves which are linear approximations of the mine-by-mine supply curves. The accuracy with which the linear segment supply curves are constructed is subject to the condition that the cost for an individual mine be no more than 10% different from the linear approximation of that mine's cost. This error is not significant for the overall solution of the linear program since that solution is based on the total cost of coal supplied, but it does become significant in the determination of the cost at which an individual unit of coal is supplied or in the determination of the marginal cost of coal supplied.

The cost of electrical energy derived from coal as delivered to users is made up of not only the cost of mining coal, but also the costs of transporting the coal and converting the coal to electricity. These costs vary by region and type of coal utilized, but conversion costs are on the order of one-half the total cost of electricity and transport costs range from about 5 to 30 percent of total electricity cost. Thus in terms of the total cost of electricity, the potential maximum error introduced by the errors involved in the linearization of the supply curves is reduced to 5 percent or less. The analysis of marginal costs must keep this range in mind.

One of the quantities calculated by the impact model is the total national cost of generating energy from coal. The model determines the production requirements of each producing region so as to minimize the total national cost. The total cost of generating the total national coal energy requirements for each of the two control levels can be compared. The cost of coal utilization is expressed in terms of cents per KWH equivalent of energy used. This total cost is an average cost over all units of coal utilized and is thus not subject to the "linearization error" discussed above since the linearization procedure balances overestimates with underestimates.

Table V-25 presents a comparison of the total national cost for BAT-2 and BAT-4 relative to BPT (the reference case). The national cost of generating electricity would not be expected to increase under BAT-2 control technology and by only 0.7% under BAT-4. These price increases are for power at the generating plant; the costs of distribution to ultimate customers would reduce the percentage increase by about 30% since about 30% of the total delivered cost of electricity is accounted for by distribution and other non-generating costs(1).

Thus, consumers would face electricity price increases on the order of only 0.05% for BAT-4. In terms of aggregate consumer prices, the price increase would be further attenuated since data analysis of the Bureau of Labor Statistics (2) indicates that only 2% of consumer expenditures are for electricity. Thus, the overall impact of BAT-4 on overall consumer prices would be less than 0.01%.

The impact in specific regions is, however, somewhat more significant. Coal is not traded in a single national market, but rather moves from specific supplying regions to specific demand regions. The costs of transportation mean that location of supplies relative to demand is an important factor in determining costs.

Since each demand region may purchase coal from a number of supply regions, the impact on the price paid for electricity generated from coal in the demand regions is not as diverse as the coal production cost impacts in the supplying regions.

Table V-26 shows the expected 1984 costs of electricity generated from coal by Census Regions. These costs are based on the marginal cost of coal supplied. That marginal cost is not comparable to the average total cost presented in Table V-25, because the marginal costs are subject to the error considerations discussed above.

Table V-26 shows some regional variation in impact on cost of electricity under each of the two effluent control levels. The important implication of these figures is that no dramatic regional energy price shifts would result from the effluent regulations. The rank ordering of regions by energy cost remains the same under each case. The difference between the lowest-and highest-cost regions also shifts only slightly. Under BPT, the New England electric energy costs from coal are 32.2% more expensive than in the Mountain States; and under BAT-4, 32.0% more expensive. These relative shifts would not be expected to be significant, or to result in any discernable shift in energy use patterns.

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(1) Federal Power Commission, Typical Electric Bills 1977, Report FPC-R90, Washington, D.C.

(2) U.S. Department of Labor Bureau of Labor Statistics, Consumer Expenditures Survey Series: Interview Survey 1972-73, Average Annual Income and Expenditures for Commodity and Service Groups Classified by Family Characteristics, Report 455-4, Washington, D.C., 1977.

TABLE V-25

ENERGY COST IMPACT FOR THE NATION

	Cost ¢/KWH	Difference From BPT, ¢/KWH	Difference From BPT, $MM/Year
BPT			
Contract Market Coal	2.95	-	-
Spot Market Coal	3.37	-	-
Total Energy Coal	3.03	-	-
BAT-2			
Contract Market Coal	2.95	0.00	0.0
Spot Market Coal	3.39	0.02	64.0
Total Energy Coal	3.03	0.00	64.0
BAT-4			
Contract Market Coal	2.96	0.01	142.0
Spot Market Coal	3.43	0.06	190.0
Total Energy Coal	3.05	0.02	332.0

TABLE V-26

REGIONAL ELECTRICAL ENERGY COST IMPACT

(Electricity from Coal)

	BPT (¢/KWH)	Difference from BPT BAT-2 ¢/KWH	BAT-4 ¢/KWH
New England	3.74	0.0	0.2
Mid-Atlantic	3.55	0.1	0.5
East North Central	3.45	0.0	0.1
West North Central	3.08	0.0	0.1
South Atlantic	3.51	0.0	0.0
East South Central	3.41	0.0	0.0
West South Central	3.22	0.0	0.0
Mountain	2.83	0.0	0.0
Pacific	3.12	0.0	0.0

Source: Arthur D. Little, Inc. estimates from Impact Model.

VI. COAL PREPARATION PLANTS

A substantial portion of the nation's coal is not shipped "as mined", but is put through a beneficiation process known as coal preparation. The basic function of coal preparation is to remove non-coal rock (ash) resulting in a coal with higher BTU's per pound and lower sulfur levels. Different coals are put through different coal preparation processes and metallurgical coals are generally the most intensively prepared.

Table VI-1 shows the tons of coal produced and prepared in various states in 1977. The table shows that generally the high-sulfur midwestern coals are most likely to be prepared, followed closely by eastern underground coals. Western surface-mined coals are used virtually as mined.

A zero-discharge effluent limitation on coal preparation plants will increase the cost of operation of those plants. Total NSPS compliance costs for preparation plants have been estimated in a previous study for the EPA.[1] These costs, for a model plant of 3 million tons per year capacity, are shown in Table VI-2. The EPA has also made compliance cost estimates for different sizes of plants based on the current Development Document; these are also shown in Table VI-2.

The EPA cost estimates include only capital costs. These capital costs have been translated into annual operating costs using the same ratios of annual amortization and operating and maintenance costs as used in the earlier EPA study. These estimates are shown in Table VI-2.

The net result is an incremental cost to meet the zero discharge limitation of between 4.2 and 16.0 cents per annual ton. These estimates are most likely an upper limit on the cost since they are based on the cost to retrofit an existing plant to meet zero discharge, while the standard would apply only to new plants. Costs incurred by new source sites are assumed to be the same as those that would be incurred by a major modification at an existing facility.

The potential impact of these costs can be put into perspective by comparing the costs increases estimated for preparation plants with those expected for mining under the BAT-2 and BAT-4 alternatives. The large preparation plant cost increases can be compared with the impacts for contract market mines and the small preparation plants can be compared with the impacts for spot market mines. The impact to be expected from the preparation plant cost increases should be similar to that of a mining cost increase of the same magnitude as shown by the coal mining model. The mining impact model has based its impact on the new supply-demand equilibrium based on increased control costs. The same model runs can be used to assess the reallocation

[1] U.S. EPA Economic Impact of Effluent Guidelines: Coal Mining, February, 1977 EPA 230/2-75-0586 prepared by Arthur D. Little, Inc.

TABLE VI-1

COAL PREPARATION AND PRODUCTION
UNDERGROUND MINES

	Total Production	Prepared	Percent Prepared	Total Production	Surface Prepared	Percent Prepared
Alabama	6,596	6,392	96.9	14,949	2,545	17.0
Kentucky	61,672	30,221	49.0	84,590	16.005	18.9
Maryland	264	119	45.0	2,772	0	0.0
Ohio	14,176	10,528	74.2	33,742	4,642	13.7
Pennsylvania	38,373	30,419	79.2	46,266	9,403	20.3
Tennessee	3,858	909	23.5	5,575	0	0.0
Virginia	23,057	10,104	43.8	14,567	1,983	13.6
West Virginia	73,509	49,295	67.0	21,924	3,590	16.3
TOTAL EASTERN	221,505	138,073	62.3	224,385	38,168	17.0
Arkansas	20	20	100.0	542	152	28.0
Illinois	29,411	20,823	70.8	24,082	20,892	86.7
Indiana	503	409	81.3	27,294	19,954	73.1
Iowa	253	0	0.0	260	31	11.9
Kansas	--	--	--	897	601	67.0
Missouri	--	--	--	6,366	1,410	22.1
TOTAL MIDWEST	30,187	21,252	70.4	59,441	43,040	72.4
Colorado	4,285	2,738	63.8	7,704	0	0.0
New Mexico	741	738	99.5	10,343	70	0.6
Oklahoma	--	--	--	5,978	565	9.4
Texas	--	--	--	15,865	1,324	8.3
Utah	8,581	2,839	33.0	--	--	--
Washington	--	--	--	5,057	5,057	100.0
Montana, N. Dakota & Wyoming	--	--	--	95,917	0	0.0
TOTAL WEST	13,607	6,315	46.4	140,864	7,016	5.0

Source: U.S. Department of Energy: Bituminous Coal and Lignite Production & Mine Operations - 1977 DOE/ETA-0118 (77) Table 22, page 49

TABLE VI-2

COMPLIANCE COSTS ASSOCIATED WITH WATER CIRCUIT CLOSURE FOR COAL PREPARATION PLANTS

(1978 Dollars)

Preparation Plant	Model C[1]	"Model T"[2]	"Model S"[2]
Capacity (ton/hr)	1000	1000	200
Annual Capacity (ton/year)	3,000,000	3,000,000	600,000
Hours per day	14.5	14.5	14.5
Days per year	230	230	230
Effluent Flow Rate (GPM)	1500	6000	1200
Percent Solids in Effluents	15	15	15
Capital Investment			
$	1,617,000	700,000	538,000
($/Annual Ton)	0.54	0.23	0.96
Amortization ($)	189,215	81,900	62,946
Operating and Maintenance ($)	100,703	45,588	33,221
Annual Operating Costs			
$	289,918	125,488	96,167
($/Ton Coal Cleaned)	0.097	0.042	0.160
(% of Preparation Charge)	3.7	1.6	6.2

Includes costs for closure of water circuit for preparation plant and water treatment with storage of refuse and coal storage.

Source: 1) U.S. EPA Economic Impact of Effluent Guidelines: Coal Mining, Feb 1977 EPA 230/2-75-0536, Table 66, 1974 dollars adjusted to 1978 dollars.

2) U.S. EPA Effluent Guidelines Division, Memorandum from Dennis Ruddy to Harold W. Lester, May 18, 1980, Table (unnumbered) "Coal Preparation Plant Facility Costs to Achieve Zero Discharge."

of coal supply due to a similar cost increase due to preparation plant effluent limitations.

The cost increases for coal mining to achieve BAT-4 for contract mines are on the order of $0.20 to $1.00 per ton in eastern areas for contract mines (Table V-1). The cost increases for preparation plants are on the order of $0.10 per ton (Table VI-2). The expected increases for large coal preparation plants are smaller than the costs associated with BAT-4 controls on the mining industry. The impact of the BAT-4 controls on production, prices, employment, etc. was found to be very slight. The impact of the effluent limitation on large preparation plants should be less.

The costs faced by small preparation plants are considerably larger, but the costs to meet BAT effluent limitations for spot market mines are also substantially higher than for contract mines. The cost increases for spot market mines associated with BAT-2 range from $0.05 to $0.65 per ton for eastern mines (Table V-2). The preparation plant cost increases are within that range. No discernible impact was found for BAT-2 control in terms of production or employment, thus no impact is expected from the effluent limitation on small preparation plants. The effluent limitations are not expected to have any measurable impact on the expansion of preparation plant activity.

VII. LIMITS OF THE ANALYSIS

A. Summary

The impact, as measured by the decrease in the consumption of coal from an impacted supply region, will have been underestimated or overestimated if the "demand elasticity" of coal from the impacted supply region(s) was respectively under- or overestimated relative to the "demand elasticity" of coal from the other regions.[1]

The "demand elasticity" specifies the decrease in demand for coal from a supply region in response to an increase in the cost to the user of an incremental unit of coal from that supply region. This "demand elasticity" is increased by the incremental compliance cost estimated to result from regulations.[2] The increase in the total user cost of coal will cause a large decrease in the use of that coal if the "demand elasticity" is high and it will cause a small decrease if the elasticity is relatively low.

The total user cost of an incremental unit of coal from a supply region will consist of the sum of:

- Production costs;
- Compliance costs;
- Transportation costs; and
- Utilization costs (handling, burning and clean-up costs).

An under- or overestimation of the "demand elasticity" can occur because of a systematic under- or overestimation in any of these four different costs. This systematic error in the different types of costs can be caused by aggregation errors in the (non-sampled) data used in the analysis.

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[1] "Demand Elasticity" $= \frac{\Delta(\text{Demand})}{\text{Demand}} \Big/ \frac{\Delta(\text{Cost per Ton})}{\text{Cost per Ton}}$

[2] The lowest end of the coal supply curve of an impacted supply region is made up by mines with low production costs and negligible mine flows and, therefore, negligible compliance costs (see Figure IV-5). As a result the lowest part of the supply curve of a given supply region will not change when compliance costs resulting from stricter standards in mine water treatment are added. However, the higher end of the supply curve is shifted upward when compliance costs are added, resulting in a higher cost per incremental unit of supply; this will cause a relatively larger decrease in the demand of that coal per unit increase in the cost of that coal: the "demand elasticity" of demand for that coal has increased.

* U.S. GOVERNMENT PRINTING OFFICE: 1983 381-082/334

The use of sampled data for labor productivities of new mines,[1] mine water flows and mine water acidity establish a range within which the impact estimate cannot be determined: the impact estimate is statistically insignificant within this range. The "demand elasticity" is indeterminate within that range because the underlying sampled data for mine water acidity, mine water flows and new mine productivities are indeterminate within a corresponding range.

The impact estimates for BAT-4 are generally significant in a statistical sense: the estimated impact exceeded the range within which impact estimates are indeterminate because of the use of sampled data.

The extent of systematic errors possibly existing in the data cannot be estimated. Sensitivity tests demonstrate that the supply impact estimate is relatively insensitive to systematic errors in the user cost of the coals from the different supply regions. However, the impact estimate for the impacted supply regions - regions where supply decreases because of relatively high compliance costs - is highly sensitive to an underestimate of the compliance costs (but relatively insensitive to an overestimate of the compliance costs).

Because data on mine water flows are only available for highly aggregated supply regions - the Appalachians, the Midwest plus Central West, and the rest of the U.S. - the water treatment cost estimates are the limiting factor in the impact analysis.

The use of average cost data for mine production costs, transportation costs, and utilization costs in the impact analysis has most likely resulted in an overestimate of the decrease in the use of coal from regions impacted by increased compliance costs.

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[1] Including replacement mines